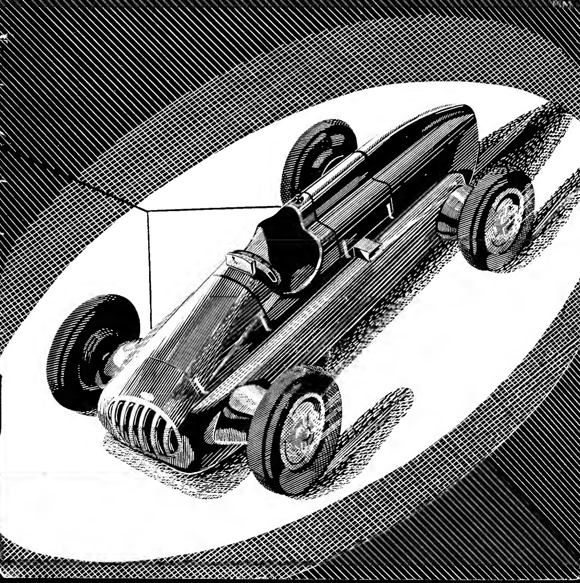
THE MODEL ENGINEER

VOL. 96 No. 2387 THURSDAY FEBRUARY 6 1947 9d.



THE
MODEL ENGINEER
Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2

SMOKE RINGS

Our Cover Picture

THE spotlight of attention is focussed this week on "The M.C.N. Special" model racing car. Our artist has given a lively impression of the car which has been designed especially for the readers of our companion journal, *The Model Car News*, as mentioned in a "Smoke Ring" in the January 23rd issue. Model racing cars are rapidly gaining popularity, and speeds in this country are gradually approaching those claimed by the exponents of the hobby in the United States, 74 m.p.h. having been achieved already, and there are several designs under way which will push our speeds up and up. Quite apart from the pursuit of speed, there is a growing field of interest in models of definite prototypes, such as historic racing cars, where realism is given pride of place to performance. We would very much like to see a model steam car, either an all-out speed model, or an accurate model of some prototype, to lend variety to club meetings.

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Vol. 96 No. 2387
FEBRUARY 6th, 1947

Our Queries and Replies

IN pre-war days our "Queries and Replies" column was a very popular feature of THE MODEL ENGINEER. Owing to space limitations imposed by paper shortage, it became a wartime casualty so far as publication was concerned. This service to our readers has, however, never been suspended, and behind the scenes we have dealt by post with hundreds of the little problems which arise in the home workshop. Now that we have rather more space available, we propose to resume publication of a selection of our replies to readers' queries, with the knowledge that the information given to one reader will be of interest and possible service to many other readers. We have drafted a set of rules governing the working of this department and would commend the observance of these rules in the interests of all concerned. We have discontinued the condition requiring the enclosure of a coupon cut from the current issue, as we find that many readers dislike mutilating their favourite paper. This condition was in the nature of a safeguard to ensure that our service was called upon only by our regular readers, but we are now leaving it to the good faith of those who wish to enlist our assistance.

Pontefract Progress

ANOTHER society for Yorkshire enthusiasts has recently been founded at Pontefract. From a programme of their meetings held during the past six months it is obvious that their members have a wide range of interests and some very capable lecturers. Visits to the L.M.S. locomotive sheds at Normanton, the L.N.E.R. works at Doncaster, and to the works of the Myford Engineering Co., made very agreeable outings. The Chairman, Mr. Charles M. Tait, tells me that he planned the Society in collaboration with Mr. J. Lea, formerly of the Romford Society, and they now have a very useful workshop in being. Mr. Tait extends a cordial welcome to prospective members; his address is 183, Willot Park, Pontefract.

Let the Windmills Revolve

I AM pleased to learn that my recent note on the banning of a wind-power electric lighting plant in Edinburgh was not strictly in accordance with the facts, due to my information being derived from a rather loosely-worded newspaper cutting. It appears now that the ban was not imposed on the use of a wind-power generating plant as such, but on the application of the current so produced to the lighting of a shop window in contravention of a regulation temporarily forbidding the use of electricity for shop-window lighting in general. This in present circumstances is quite understandable, and so the wind-power generator leaves the Court without a stain on its character.

A New York Move

THE New York Society of Model Engineers has found a happy solution to the problem of a permanent home for its meetings and for its very fine model railway layout. In its twenty-year history the Society has been obliged to make three residential changes, but through the courtesy of the Lackawanna Railroad, it has now been granted a lease of some 9,000 sq. ft. of space at the north end of the upper concourse of that Company's Hoboken terminal. I understand that in addition to housing the Society's model layout, arrangements will be made for a race track for model cars, and that power-boats and 'planes will also have facilities provided. It is a curious fact that the Society's new quarters are not only not in New York City, but not even in New York State!

His Friend, the Lathe

A BUXTON reader's letter reflects the friendship which a true model engineer feels for his lathe. He writes :—" Since last writing you I have managed to acquire another workshop. When I left Sheffield two years ago I was obliged to dismantle my then workshop and I sold my lathe. Then for fifteen months I was more or less miserable. It is true I cheered up each Thursday when I received my copy of ' ours,' but I missed my tools. However, owing to the good offices of two friends, I now possess a workshop measuring 12 ft. by 8 ft. together with a brand-new lathe. Everything is not just as I would like it yet, but I can at least make things, and before long I hope to have it all just as I want it. Incidentally, I got my lathe running on the evening of Christmas Day, so you can bet I enjoyed my Christmas."

The Magic of the " M.E."

HAVE you felt the magic of THE MODEL ENGINEER? It is unusual, it is a little mysterious, but it is very real. Listen to this from an engineer reader to whom I was recently able to render a very modest service. He writes :—" Your letter is really helpful and inspiring, it has given me a new outlook altogether. There is another point too, from the inspiration of THE MODEL ENGINEER I have had countless really happy hours, some of the best I have ever had. THE MODEL ENGINEER has been helpful in creating ideas, it has helped me to improve my workshop efforts, it has had a good effect on my industrial work, and has created poise in myself—a feeling of being self-reliant. All that is directly due to you." Where does the magic come from? It arises largely, I think, from the fact that all our readers are engaged in creative work, in giving expression to their desires and achievements in their workshops, and through our columns pooling their knowledge, their advice, their hopes, and perhaps even their failures and disappointments. An article may describe a very simple model, or an advanced workshop operation ; it may describe experiences with a locomotive or a power-boat, or it may be just a ripple of enthusiasm from a club meeting or an exhibition. But all these things have their common human touch, and each reader as he browses over the other fellow's writing can feel " it might be my job," or " it might be me." We even have our little " scraps " between readers in our correspondence columns, and at times I am sure there is a chuckle when " Smoke Rings " gets politely rapped over the knuckles because THE MODEL ENGINEER is not what it ought to be, or what it used to be. All these things are, however, taken in good part, and however bright or however dull a particular issue may appear to be at a first glance, there is always something which touches the spot and is worth a second thought. The fact is that the magic of THE MODEL ENGINEER is that it is alive, it reflects the feelings and the work of thousands of real human beings actuated by a remarkable mutual good will and keen intelligence. My present correspondent winds up by a grateful appreciation of our staff and our contributors ; he says, " You are a real grand team." I accept this compliment on the understanding that it includes our readers as well, for everyone in his own way by his continued interest in our doings is responsible for the magic of THE MODEL ENGINEER.

Cornish Co-operation

THERE is news from Perranporth of another live Cornish Society. Enthusiasm and ambition rather than extensive membership are the dominating qualities of this new organisation at the moment, but these are the roots which will make for growth. Visits, an exhibition, a regatta, and an outdoor multi-gauge track are all on the programme, and a recent modest exhibition as a trial run in aid of a local War Memorial Fund proved a great success. Both the Truro and the Malden Societies lent a hand on this occasion, which I am told brought to light the fact that in the district there were a number of model engineers who had hitherto been hiding their light under a bushel. The Hon. Secretary is Mr. R. A. Smith, c/o Mr. A. A. V. Westcott, St. Piran's Road, Perranporth, so rally round, Cornishmen.

Calling Hayes, Middlesex

MR. GORDON GREEN writes to say that the response to his recent appeal is very good, and that a meeting will take place on Thursday, February 6th, at 7.30 p.m. at Cherry Lane Hall, Harlington. Buses 90B and 98 stop at Cherry Lane.

Percival Marshall

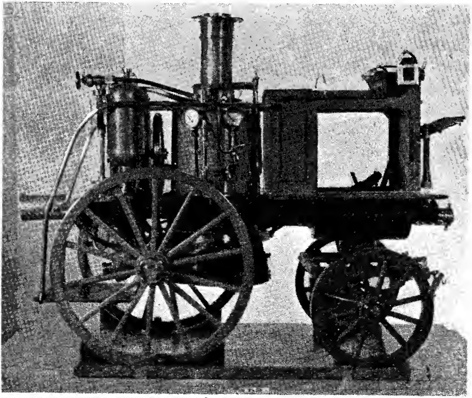
A MODEL STEAM FIRE ENGINE

The Shand Mason Type of 1876

By H. S. Goodman

THE construction of a working model steam fire engine of the above make had been in my thoughts for many years. About the year 1885, (I was then 12 years of age), I went to a school in Avenue Road, Acton, London. Next door to this school resided a Mr. T. Coates and his brother, both celebrated model engineers. When sitting in the schoolroom we often observed a stream of water projected to a great height from Messrs. Coates's garden. This aroused the pupils' curiosity, and upon enquiring of the schoolmaster, he informed us that Mr. Coates was working the model Shand Mason Steam Fire Engine he had constructed. In due course, Mr. Coates gave us an invitation to see the model. He had it placed on an old kitchen table; on a chair nearby was a bath of water, and every now and then he would elevate the delivery nozzle and send a stream of water the height of a fair-sized tree. His brother was kept busy stoking the boiler with small pieces of wood. Mr. Coates later sold this model, and I think it is the one now in the possession of the Science Museum.

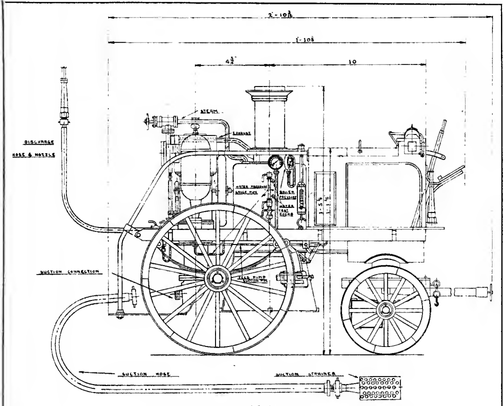
It was not until about four years ago that I started on what I had in mind for such a long time. I was then about 70 years of age, and having retired from business, set about the task of getting some drawings. These, however, were unobtainable. Shand Mason and Co. had given up their business years before. I enquired of *The Engineer* and *Engineering*, but they could not help me. Finally, I wrote to the Science Museum, and they very kindly gave me certain data, and later on supplied an excellent photograph. It was from this I completed the work. I made a set of patterns, but, owing to the war, could not get anyone to supply castings. It looked as if I should have to give up the project. Sometime later, I was in Mr. G. Kennion's shop, and on his bargain counter observed the casting of a cylinder that looked as if it would serve the purpose. I found, however, that the bore was a little larger than required, to scale size, also the stroke. However, the working is not affected, the boiler being easily master of the engine. Later on, I called again at Mr. Kennion's shop, and he supplied me with many bits and



pieces, which helped me on my way considerably. The most difficult part I experienced was the construction of the road wheels. These are made in wheelwright fashion, morticed, tenoned and dowelled. The tyres are shrunk on, and they hold the lot securely. I was not satisfied with the back wheels, as they were not dished sufficiently, so another set was made, which proved much more like the real thing.

The model is constructed to a scale of 2 in. to the foot, and with the exception of the cylinder already mentioned, every part was built up, including the pump barrel, all flanges, etc., being turned from brass or bronze rings, forced on and silver-soldered. Similar methods are employed in the construction of the discharge water box, chamber space, and set for a working pressure of 95 lb. per sq. in. The barrel and combustion chamber are of solid-drawn copper tube, the ends being of copper sheeting, and flanged. The inner and outer fireboxes are also of copper sheeting, a template having first been drawn out on a stiff sheet of paper, the shape and size of the development, after which it was marked out on the copper. The usual fittings are provided on the boiler, such as pressure and water gauges, blower pipe, test cocks, and two Salter spring balance safety valves.

The vehicle itself is mounted on wheels, axles and springs, of the type common to those employed carrying heavy weights at high speeds, such as were used for mail coaches.

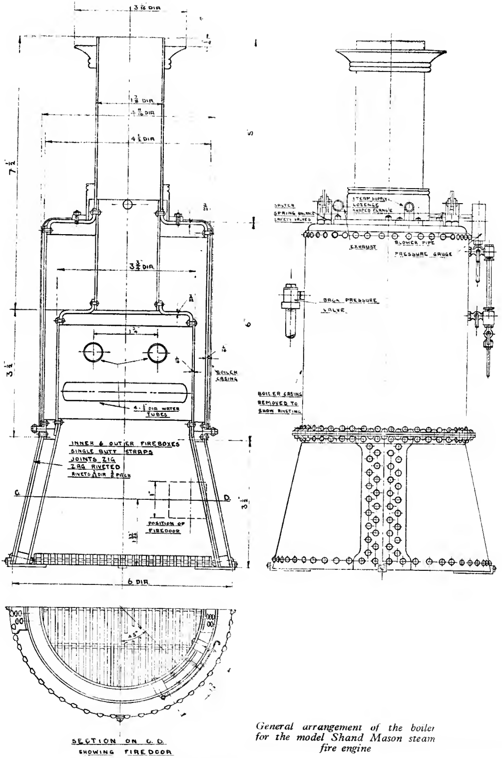


Side elevation of the model Shand Mason fire engine

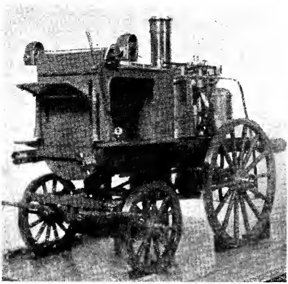
which is made from ⅛-in. thick brass plate. The suction and discharge air vessels are of copper tube, the ends being spun over a hardwood former, the whole thing then being brazed together. In fact, the only part of the machine that was ready made was the test cock on the discharge side of the feed pump. This can be seen in the drawing. It might be added that this I had by me, and was intended for another job.

The boiler, as can be seen in the drawings is of the vertical central-flue type, with four ½-in. diameter water tubes across the combustion

The action of the machine is as follows:—Water is drawn through the hose connection, below the foot valves, by the up stroke of the plunger, the returning down stroke closing the foot valves, the trapped water then opening the bucket valves and passing to the top side of the bucket, whence, on the next up-stroke, the water is discharged into the waterbox, and regulation of the two discharge hoses and nozzles is made by means of the regulating valves. Motion is transmitted to the pump plunger by means of two piston-rods, arranged so as to miss the crank, the pump ends of these rods being

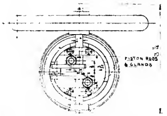


General arrangement of the boiler for the model Shand Mason steam fire engine



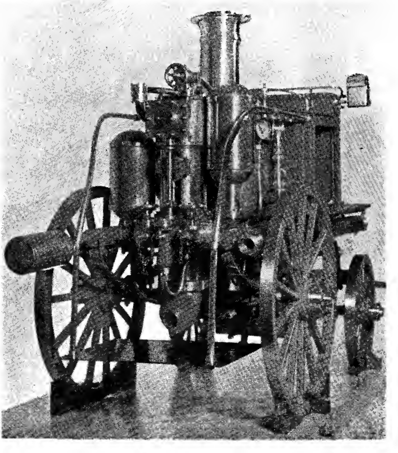
attached to the plunger by means of forked ends and pins. The connecting-rod small end is attached to the base of the plunger, the function of the crankshaft being to carry the flywheel, and drive the steam slide valve and the boiler feed pump. The water supply for this pump comes from a tank forward of the boiler. A supply of coal is carried in a bunker secured to the front axle. Lengths of suction hoses are carried on hangers along the chassis, while the delivery hoses are coiled up and stowed in the open space between the feed tank and the driver's seat.

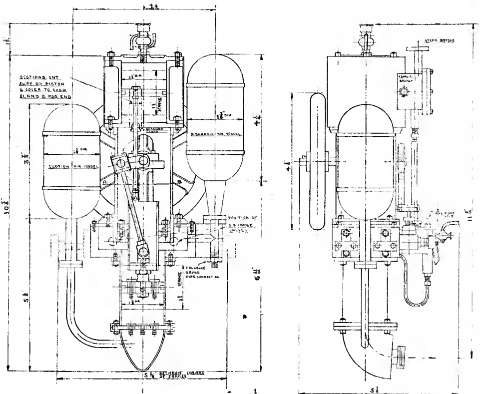
In conclusion, I wish to record my indebtedness to my wife, in obtaining many bits and pieces, for instance, to mention but one item, the leather for making the delivery hoses. Also to my son, an ex-chief engineer of the Royal Fleet Auxiliary, who made the drawings for the purpose of this



Section on A.B. of the engine, looking at bottom cylinder cover

article, and last, but by no means least, to my friend Mr. Longley, for his kindness in taking the photographs which appear with this description.





General arrangement of the engine for the model fire engine

For the Bookshelf

Railways, Vol. 8, No. 81, January, 1947. (London: Railway World Ltd., 245, Cricklewood Broadway, N.W.2.) Price 1s. od. monthly.

During the past eight years, this periodical has been under the editorship of Mr. G. H. Lake, who, despite the prevailing difficulties, has succeeded in building up a good reputation for his paper. Circumstances, however, have compelled him to relinquish the editorial control, and he has been succeeded by Mr. R. J. Raymond who, as editor of *The Model Railway Constructor* during the past ten years, is no stranger to a large following, and we know that we share with many readers our good wishes for success in his new post. The first issue of *Railways* under Mr. Raymond's control contains a number of subtle but pleasing changes of appearance, while the contents are well up to the standard of interest that we have come to expect from our contemporary.

Aircraft of the Fighting Powers, Vol. VII. Compiled by O. G. Thetford and E. J. Riding. The Harborough Publishing Co. Ltd., Allen House, Newarke Street, Leicester. Price 31s. 6d.

This volume completes the series with the above title, and carries in its last pages a complete index of all the aircraft featured in the previous six volumes.

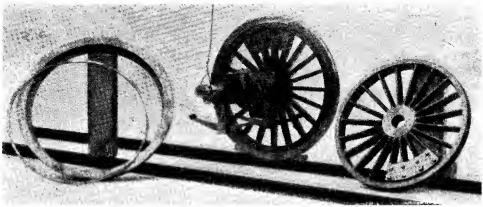
Volume VII describes in the same manner and style as Vol. VI, 34 British, 1 Australian, 18 U.S.A., 13 German and 4 Japanese aircraft, by photographs and a three-view drawing of each type. Not all the drawings are up to the standard of accuracy achieved in the previous volume. Comparing the photographs with the drawings reveals that such things as undercarriage details and airscrews are still giving trouble to the draughtsmen, *vide* the Australian CA-15 and the Focke Wulf Ta 152H, to quote but two instances.

The photographs and technical write-up have maintained the previous high standard. The former are well chosen and clearly reproduced on art paper. We would, however, point out one slight mistake on page 31 in the historical section. The Breguet biplane had variable incidence wings at least two years earlier than the Paul Schmitt quoted.

Those who have had the previous volumes will naturally wish to add this last to form the set, and the book should find a ready market among the air-minded which naturally includes a large proportion of 1/72nd scale solid model enthusiasts.

Locomotive Tyre Fastenings

By G. WOODCOCK



Carlton's fastening as applied by the writer on a model G.W.R. " Single "

THE first instance we have of locomotive tyres are Hackworth's " Plug Wheels," 1826; but as they find no place here, no extended reference to them need be made.

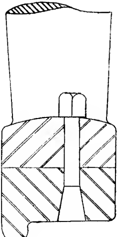
The first practicable tyre fastenings are shown at Figs. 1 and 2. No. 1 had the obvious drawback that, if the bolts passing through the tyre were of a softer material, flats soon developed. At that time, however, tyres were only of iron, although at Swindon, in 1840, Gooch was producing tyres of one-fifth part best shear steel. It was, generally, not until Krupps introduced rolled steel tyres in 1851 that their use became more frequent, and then only slowly.

Fig. 2 shows the G.W.R. retaining method of the 1845 period. It may be remarked that this seems extremely insecure fixing.

Fig. 3 shows a system which has become widely used. The tyre, after being shrunk on to the wheel centre, is drilled and tapped for retaining screws. This system ensures that a tyre will not fly off a wheel should it break into several pieces.

Fig. 4 shows a system which found some use around the latter half of the last century, notably on the Great Eastern Railway.

Fig. 5 shows a method which had some use; but the turning of the lip on the tyre and the subsequent hammering down on to the wheel centre proved troublesome. Further, it did



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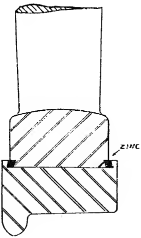

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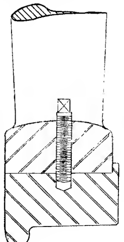

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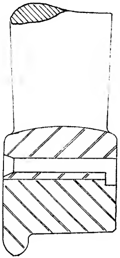

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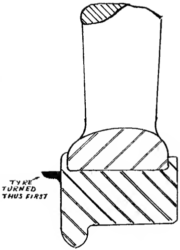

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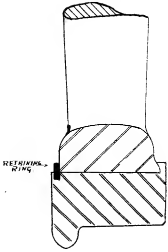

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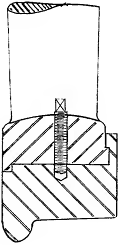

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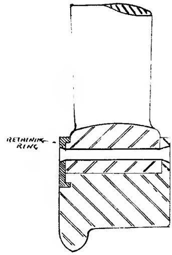

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not preclude pieces of the tyre flying off should it break.

Fig. 6 shows S. Carlton's tyre fastening used by the Great Western Railway. When this system is used, it is usual to increase the tyre skrinkage allowance to 0.012 in. per ft. dia., as against the more usual 0.010 in.

Fig. 7 is an improved version of Fig. 3; it is more expensive and the writer can recall instances of the tyre going half on and "getting stuck," to the acompaniment of much obsccnity. It had, however, the advantage of additional security by the lips.

Fig. 8 is an improved version of 4, and still finds some use, but is, of course, very costly.

It may be mentioned that the piercing of the tyre itself is always open to doubt. The American method relies upon shrinkage and the side lip only, but the writer believes the shrinkage allowance is greater than anything in use in this country.

Tyre fracture is always a constant anxiety to the locomotive engineer, and a variety of other tyre fastenings have been patented; but these shown here have had the most extended use.

Those of which the writer has had experience are 3, 7 and 8. In connection with 8, I recall a pair of wheels requiring a new axle and tyres which were wanted in such a tearing hurry that after pressing on the wheels they found the retaining rings had not been put on the axles!

The Original Baker Valve-Gear

By K. N. Harris

THE valve-gear illustrated herewith is that originally designed by Baker, sometime prior to 1915, and applied to a "Uniflow" traction engine.

As those familiar with the older radial gears will recognise, it belongs to the Marshall variation of the Hackworth family.

The original description of this gear was published in *The Engineer*, I would say around 1915 or 1916. (I have the cutting, but the date is missing.) It is very similar to the American Southern gear, in fact, in principle, identical.

The main difference between this gear and the ordinary Marshall gear is the introduction of a bell-crank and a connecting link between it and the eccentric-rod, to bring the valve motion into the same horizontal plane as the piston-rod.

The Baker gear has gone through one or two metamorphoses since this original gear, and the essential difference between it and the modern gear is Baker's adoption of a combination lever, deriving its motion from the crosshead, to provide the "Lap plus Lead" motion of valve; this was, of course, the outstanding feature of Egide Walschaerts' invention of over 100 years ago.

The drawing, Fig. 1, carries its own key, setting out the functions of the various parts, and is pretty well self explanatory.

This is the layout of the gear as actually applied to the traction engine which had the valve at the side of the cylinder.

If it were desired to place the valve above or below the cylinder this could be done by altering the position of the fulcrum of the bell-crank so as to bring the connection to the valve-rod into the desired location. This would, of course, entail lengthening the link "F" to suit.

Alternatively, the bell-crank could be arranged with its long arm *above* the fulcrum and the eccentric turned through 180 degrees.

The engine for which this gear was made was of considerable interest inasmuch as it was not only operated on the "Uniflow" principle, but the cylinder incorporated an auxiliary exhaust valve which was operated quite automatically by the main valve through subsidiary ports, there being no mechanical control whatever.

Properly proportioned, this valve-gear gives a thoroughly satisfactory steam distribution; like all true radial gears, it gives a fixed lead.

Incidentally, what is the best steam distribution?

There is a prevalent idea that Baker's valve-gear (modern form understood) gave a better steam distribution than did Walschaerts'; the reason given is usually that Baker's gear had no slotted link and die to introduce die slip. I have no quarrel with that, but I am quite sure there are many well-qualified people who would not agree with it, and would most certainly not accept it as a *fact*. In every valve-gear of a practical nature there are inherent errors of one sort or another; die slip is only one of them.

The errors caused by the angularity of absurdly short eccentric-rods are at least equally serious.

In the issue of THE MODEL ENGINEER, dated October 12th, 1931, Mr. C. M. Keiller gave in tabulated form the actual valve events on one of

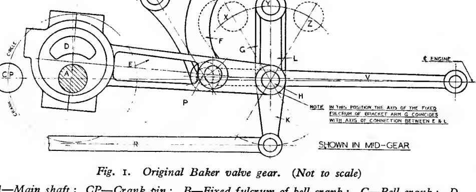


Fig. 1. Original Baker valve gear. (Not to scale)

A—Main shaft; CP—Crank pin; B—Fixed fulcrum of bell crank; C—Bell crank; D—Eccentric; E—Eccentric-rod; F—Link connecting eccentric-rod and bell crank; G—Bracket arm carrying swing link L; H—Fulcrum of G and connection of L to E; K—Drop arm controlling G; L—Link connecting outer end of E and short arm of C; P—Connection of long arm of bell crank to valve-rod V; V—Valve-rod; R—Reach-rod to reversing lever; XYZ—Path through which G can be moved

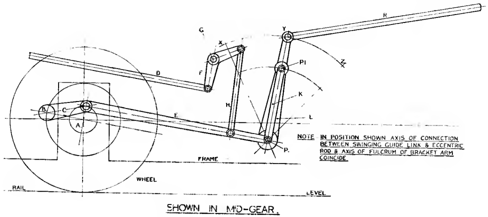


Fig. 2. Andrew Barclay's modification of Marshall valve-gear. (Diagrammatic)

A—Axle ; B—Crankpin ; C—Return-crank ; D—Valve-rod ; E—Eccentric-rod ; F—Bell crank ; G—Fixed fulcrum ; H—Link connecting eccentric-rod and bell crank ; K—Swinging guide link ; L—Bracket arm pivoted at " P," " K " pivoted to it at P1 ; R—Reach-rod to reversing gear ; XYZ—Radius of movement of " L "

his $\frac{1}{2}$-in. scale models with Walschaerts gear. In the " Journal of the Institution of Locomotive Engineers," Vol. 33, page 429, will be found, also tabulated, an analysis of a modern full-size Baker gear made in this country for a Dominion railway. The events of both are good, but the Baker gear certainly cannot claim to be *better* in this instance on any grounds, and I have very great doubt as to whether any Baker gear applied to a $2\frac{1}{2}$-in. gauge locomotive, up to now, can equal, let alone beat, Mr. Keiller's gear referred to.

Mr. H. Holcroft, one of the greatest living authorities on locomotive valve gears, has stated :

" In the case of a shifting link eccentric-gear, such as the Stephenson or Allan straight link gear, not only did the angle of advance increase with the notching up, but so, too, did the amount by which the valve was opened : i.e., they gave variable lead. That was a most valuable asset of the Stephenson gear, in that the valve was well open for early cut-offs at the beginning of the stroke ; and an engine with Stephenson gear, if it was well designed, would give a larger mean effective pressure and horsepower for the same size of cylinder, than other forms of gear operating reciprocating valves. *By reduction of lead in full gear it gave greater accelerating power from rest.*"

These views were spoken during the discussion on Mr. Shields' excellent paper, " The Evolution of Locomotive Valve Gears," before the Institution of Locomotive Engineers, in September, 1943. Incidentally, they line up with the views and practical applications of the late Jackson Churchward.

Mr. Shields, in his summing up after the discussion, made this further remark on the subject :

" Mr. Holcroft mentioned the advantages of the Stephenson gear. It has been claimed that the Walschaerts gear, with its constant lead, was a benefit. However, he was inclined to favour the Stephenson gear, with its increasing lead towards mid gear. *A locomotive with a large amount of lead in full gear was tardy at starting.*"

Several distinguished locomotive engineers were present at the discussion ; not one of them dissented from this view.

Fig. 2 shows a diagram of a gear developed experimentally by Andrew Barclay Sons and Co., in 1922, which in its essentials is identical with the early Baker gear.

To sum up, there is certainly no *perfect* practical valve-gear ; but such gears as Stephenson's Allan's, Gooch's, Walschaerts', Baker's, Joy's, or Greenly's modification of Joy's, can each and all be designed and made to give excellent results. Equally, by poor design and workmanship, and a failure to grasp fundamental essentials, errors of considerable magnitude can quite easily be introduced into the functioning of any one of them. If, on the authority of his own statement, it took a man of the calibre of the late Jackson Churchward twenty years to master valve-gears, it will be apparent to most people that they are *not* a simple subject, and nothing will ever make them so.

It may be fairly easy to get them to operate with a reasonable degree of satisfaction ; that is quite a different matter from understanding their finer points and getting them to function with the attainable maximum of efficiency. The Patent Office files of this and other countries are sufficient evidence of the complexity of the subject.

Are You Awake?

By Wm. Cleghorn

ARE there any of us, who, having to use an alarm-clock to arouse us on dark winter mornings, do not waken up in the darkness, fumble around for the clock to switch off the alarm, or else feel around for the bedside-lamp switch, so that we may see the clock to switch it off, and very often, in the fumbling, over goes the clock on to the floor? One such fall very often necessitates extensive repairs to the works and a new glass.

Are there any of us, I repeat, who, in these circumstances, have not wished that the light was already on when we have awakened? Myself, having frequently knocked over my alarm-clock, to the detriment of the glass, have had "perspex" fitted in its place for a good many years now, to lessen the amount of possible damage from the cause referred to; this is, however, only a partial solution. Better than this, I have recently devised and made a very simple gadget which automatically switches on the light for me at the instant that the alarm begins ringing; and, as I awaken, there is the light on and no feeling around in the dark needed. The clattering alarm-clock is easily seen and switched off, and with little chance of it being damaged.

The aforesaid gadget, is simply an electric switch actuated by the alarm-clock; it is connected to the bedside lamp, switches it on without any trouble, and, furthermore, once it is set cannot fail to operate, unless, of course, the clock should stop; otherwise the thing is so simple that there is nothing to go wrong.

The main part of the switch and that which makes it so simple and fool-proof in action, is a small glass-tube mercury switch, which, as most readers already know, has no moving parts, apart from a large "blob" of mercury enclosed in a glass tube. The tube, on being tilted, causes the mercury to uncover two platinum contact wires, or, tilted back again, to bridge the wires, thus breaking or making the circuit, as may be required. This glass tube is fastened (by rubber bands) to what is, in effect, a miniature beam-scale with one end slightly heavier than the other, the heavy end, when the switch is set, rests on a peg which sticks out from the alarm wind key. (Fig. 1.)

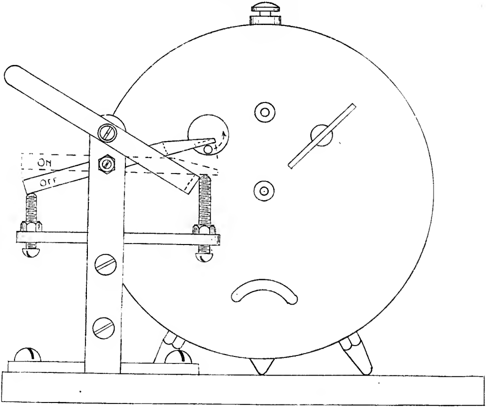


Fig. 1

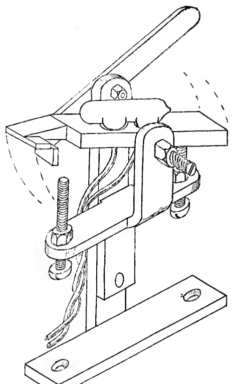


Fig. 2

Now, when the alarm goes off, the alarm winding key (as is usual in most clocks of this type), turns around as the alarm spring unwinds itself, this causes the peg to slip from under the end of the pivoted beam, allowing the beam to drop, tilting the mercury-switch, and, *voila*! the light is on.

If your alarm-clock has those winding keys which have a floppy, loose piece for a finger grip, which, for some reason or other, clockmakers delight in fitting to alarm clocks, and do not appear to serve any useful purpose, apart from lying flat against the back of the clock and eluding the fingers when one wishes to wind it, the best plan is to make the loose piece a fixture by soldering it to the boss of the key (as in sketch of details). Next, some kind of a peg, or a step must be fitted to the key, either by cutting-out a notch, or soldering a wire to project from the key.

If the key has a right-hand thread in its boss, it is a very easy matter to make a new one from an odd scrap of $\frac{3}{4}$-in. round brass; an 8- or 10-B.A. hole drilled and tapped $\frac{3}{16}$ in. off centre enables a small crankpin to be fitted (see sketch). Should the key have a left-hand thread, it may be much easier to adapt the existing key, as suggested in sketch, Fig. 4.

As the tail-end of the tilting beam has a slight projection sideways, the direction of rotation of the key as it unwinds, does not matter, the peg or notch will slip from under the end of the beam whichever way it moves.

The beam having dropped, there should be enough clearance for the key to revolve harmlessly above it; for this reason, the key, when set, should have the peg, or notch, at its lowest position. An advantage of this peg arrangement is, that the clock is not fastened in any way, and can be removed elsewhere whenever required. When the switch is to be set, the clock is merely placed in the correct place on the base board, the key having first been wound and set at the bottom of its stroke. The tail of the beam is then inserted in the slot or on the peg, and as the switch is adjusted so that the circuit is broken at this position, the subsequent dropping of the beam causes the circuit to be "made." When the switch is not in use, it is held up in the "off" position by means of a light hand-lever, which is given a small amount of stiffness in its movement, due to a spring-washer on its fulcrum-screw, and also a locking-nut fitted to it.

Should a mercury-switch not be available, the same effect can be achieved by means of the usual contacts; but, unless proper insulation is carried out, or low-voltage lighting is used, this could be very dangerous in use.

To our electrically-minded readers, a relay-operated switch would be easy to construct, but this would mean the taking away of some of the simplicity which is the keynote of the present job.

For low-voltage lighting an even simpler method exists; I can remember it from the dim distant past of about twenty-five years ago. The idea is simply this, a grooved block of wood (or other insulating material) is made, which clips on to the alarm wind key. The two wires, between which it is desired to make the circuit, each terminate in a piece of light chain, or even flexible wire would serve, the ends of these

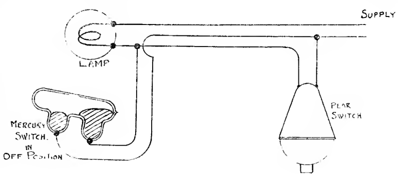


Fig. 3. Wiring diagram

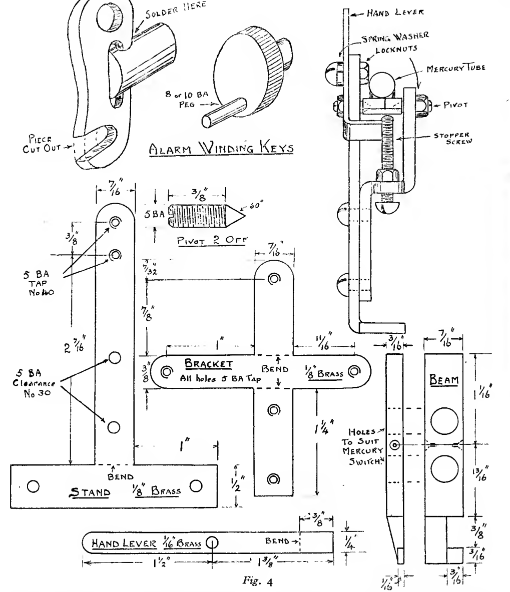


Fig. 4

chains are fastened to the grooved piece of wood, at a distance from each other, so that, normally, no electrical connection exists between them. To set the alarm, the piece of wood is slipped on to the alarm key, the chains still separated; now, when the alarm goes off, the key turns and the two chains are twisted together, thus making the circuit and switching on the light. It can easily be seen that it would not do to have 250 volts passing through these chains. A point to be considered in connection with the chains (or flexible bare wires) is that they must be long enough to be able to twist as many times as the alarm key will turn (usually five or six times).

To return to the mercury-switch, the writer favours the arrangement whereby the mercury-switch is in parallel with the orthodox pear-switch which hangs on the bed-rail, the latter can then be used independently of the mercury-switch, whether it is set or not. (Fig. 3.)

The switch described here has been in use for several months now and only failed once, when the writer set the switch but forgot to set the alarm-clock, and we can't blame the switch for that! Incidentally, the mercury-switch which has given such good service, was pur-

chased for a totally different purpose many years ago, to wit, a pressure-controlled switch for a small air-compressor, and was intended to switch on and off a $\frac{1}{4}$-h.p. electric motor, according as the pressure in the receiver rose or fell between certain predetermined limits. This idea, although it has not yet materialised, is merely in abeyance until time and inclination bring it to fruition. Then, perhaps, it will appear in these pages.

The construction and operation of the automatic time-switch, as shown in the sketches, should be, I think, fairly easy to follow. I used $\frac{1}{8}$-in. sheet brass which gives a very substantial job and gives a good thread when tapped No. 5 B.A. The two pivot screws are made from No. 5 B.A. steel screws, shaped to a centre-punch point at one end and with a fine screw-driver slot at the other. I ground my pivot points in he lathe, but those not so fortunate as to possess grinding equipment could manage just as well with a file.

The pivot-bearings in the beam are made with a small Slocombe centre-drill (or your usual centring arrangements for turning between centres). Dimensions will, of course, vary according to the size of your alarm-clock, mercury-switch, etc., those given on the sketches will serve as an approximate idea of what is needed.

Apart from being used for switching on a light, this device, by the inventively-inclined, could be made to serve a multitude of other purposes, e.g., ringing a bell in some other room ; switching on an electric kettle for tea making or shaving water ; switching on the radio for the early news ; opening the door to let in (or out) the cat or dog, as the case may be ; switching off shop signs (when once again we are allowed to use them) ; or any other purpose which has to be done at a certain specified time.

The N.L.S.M.E. Exhibition at Barnet

FOR three days, January 9th, 10th and 11th, the North London Society of Model Engineers held their exhibition of models in the Ewen Hall, Wood Street, Barnet.

There were many old friends of model engineering there such as " Uncle Jim " Crebbin, and G. H. W. Randell, who were in their element driving their respective locomotives on the two parallel passenger-carrying tracks, thus proving yet again the great appeal of steam locomotives to children and grown-ups alike.

Among the many fine locomotives on show, finished and unfinished, were noted an L.M.S. "Princess Royal," No. 6201, a free-lance 0-4-0 side-tank, a 4-6-0 + 0-6-4 Garrett nearing completion in $3\frac{1}{2}$-in. gauge, which looks promising. Also a fine part-completed "Petrolea" in $3\frac{1}{2}$-in. gauge.

Mr. G. A. Flanagan, the Society's chairman, was in charge of the de Havilland bequest—a display of steam stationary engines and boilers, which were the delightful hobby of the late Geoffrey de Havilland. These included a coal-fired vertical boiler supplying a single-cylinder vertical engine, which in turn drove a small dynamo. Mr. Flanagan also showed the capabilities of his fully automatic gas-fired boiler.

Racing cars were represented by two chassis, one by A. Weaver, which was powered by a 10 c.c., o.h.v. engine, and showed his usual high standard of workmanship and the other was a bare chassis by G. V. Woodhouse, with a novel form of front suspension.

The aeronautical section was not so strongly represented as in the 1945 exhibition, but there were one or two petrol-engined models of conventional design, which left little to be desired as far as construction and attention to detail was concerned.

Racing hydroplanes were represented by Cockman's famous " Ifit 6," and a flash-steamer by F. Chatham. The I.C.-engined boats included a 30-in. 15 c.c. job by G. O. Blomgrust, a 10 c.c. o.h.v. in a neat hull by A. Weaver, and a very neat little 3 c.c. hydroplane by H. Fisher.

Ships and ships models present included a fine piece of workmanship by W. Browning, of Hendon, namely his steam-tug *Gondia*. This was not his only exhibit, the other being a destroyer. S. V. Mercer's model of the destroyer H. 12 was a beautiful job.

In the boat section there was an interesting model of a cabin cruiser named *Enterprise*, with the hull made of layers of paper by a club member. It certainly had a super finish and appeared accurate in its lines. Of historic interest. was C. J. Drayson's famous *Nippy*, which can still give a good account of herself after twenty years

The North London Ship Model Society loaned a glass case displaying an interesting selection of waterline models.

The model railway fans were well catered for in that there was a large " OO " gauge L.N.E.R. layout in the room beyond the back of the hall, measuring 18 ft. by 10 ft., the result of three years' work by the Society under the leadership of Mr. Mascall. It was a very impressive system, using the two-rail method. The model signals were especially praiseworthy, but as yet they are not working models. This layout deservedly had a room to itself where there was plenty of room to watch operations.

From the general public's point of view, perhaps one of the most interesting features was the sound-recording gear, which was secured for the exhibition by the initiative of the Club's president, Mr. E. Stace, by means of which one could take away a permanent record of one's children's voices, which would be of great sentimental value in after years. The opening speeches of the exhibition were played back after an incredibly short time.

A Lathe Tailstock Tool Holder

By F. Hall Bramley

FOR repetition work using bar stock fed through the hollow mandrel of the lathe headstock, the twin tail-stock tool-holder shown here will be found to be a time-saver and to ensure full interchangeability of the work turned out. It has the advantage of being easy to make. It is fitted in the taper of the tail-stock barrel, the body A, of the tool, being made of $\frac{1}{4}$-in. steel plate heated red in the forge or fire and bent at right-angles. It is shown in end view in Fig. 1, and side view, in section, in Fig. 2.

Projecting from the back-plate is a centre, B, which is turned out of mild steel to a taper to fit the tail-stock sliding barrel by means of which the tool is fed up, by the hand wheel, to the stock fed through the lathe head-stock mandrel.

The outer end of B is turned to a shoulder, as shown, and the forward end is threaded. A hole is bored in the back of the body A, and threaded to suit the thread on B, and both A and B are tinned on the threads and shoulder contacts and screwed together while hot. The end of the thread is then riveted over, being left a little long for that purpose, and the end of the screwed hole slightly countersunk so that the metal is driven down by a round-paned hammer into the countersink.

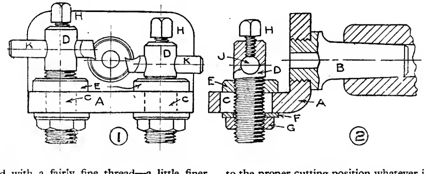
The two tool-holders, D, D, are made from mild-steel round bar, and are parallel from end to end; but about two-thirds of their length is their width. The width of the slots is such as just to clear the diameter of the screwed part of the tool-holders, D, and they are made by drilling a row of holes of the diameter just under the diameter of the tool holders D and then carefully filing them out as vertical slots with rounded ends. They allow for adjustment along the length of the work of the cutters. These tool-holders, or tool-posts, are not of equal length; the hole in one is higher than in the other, as shown in Fig. 1.

It will be seen that the cutter at the back cuts the work as it comes up at the back. The tool-holder at the front (seen also in Fig. 2) cuts the work as its surface rolls down.

Both tool-holders can be adjusted for height; *i.e.*, the height of the cutting edge relative to the work, so that cutters can be made with the front end just ground down and sideways as shown. Other cutters may be curved upwards to suit the contour; in which case, the cutter holder will be adjusted upward in the case of the front one and downward in the case of the rear one. Thus, by this vertical adjustment, any shape of cutter can be accommodated.

To allow for this up and/or down adjustment, the tool-holders are screwed for their bottom length with the fine thread mentioned. On this thread is screwed a collar E. Screwing the collar up lowers tool-holder and tool; screwing it down raises tool-holder and tool.

Thus the cutter can be adjusted vertically



screwed with a fairly fine thread—a little finer that Whitworth-standard for their diameter. The top of the tool-holder is drilled across, $\frac{5}{16}$ in. diameter, to take $\frac{5}{16}$ in. tools which will be used, and a central hole is drilled from the top to take a $\frac{1}{4}$-in. hardened, square-headed set-screw to nip the tool.

These dimensions are not necessarily definite. For heavier work, all can be made larger, in which case the tool-holders D will be made larger in diameter. The body A, is slotted at C, the length being shown in Fig. 2 and the width (dotted) in Fig. 1. These slots are rounded at the end to a radius equal to half to the proper cutting position whatever its shape.

These collars can be milled on their periphery so that they can be conveniently rotated, in making the adjustment, by thumb and finger.

The adjustment being made, the tool-post (or cutter-holder) is locked solid to the body A by the lock-nut G, an intervening flat washer F, coming between it and the bottom face of the body and straddling the tool-holder slot in the body.

It will be appreciated that this arrangement also allows for adjustment of the horizontal angle of the cutter, since the tool-holder can be

(*Continued on page* 201)

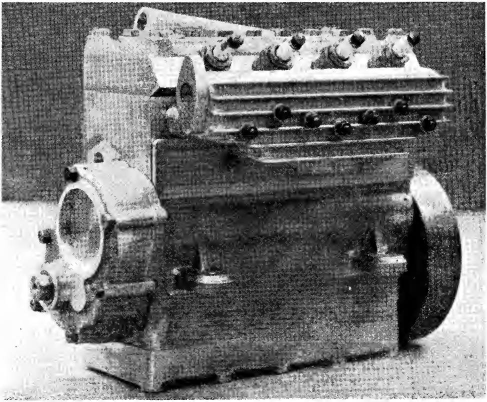
A 15-c.c. FOUR-CYLINDER ENGINE

By Edgar T. Westbury

AS a result of my article on " Multi-cylinder Developments " in the issue of December 12th, I have received many comments from readers on this subject. In a few cases, it is considered a questionable policy to introduce any complication into design, unless it can be shown that this will result in greater utility, or higher performance. Why use a number of cylinders, when one will do the job just as well ?

Here we have an instance of the attitude to which I have already referred in earlier articles, namely, the inability to consider any aspect of the model petrol engine except its function as a power unit, in other words, a mere means to an end. Granting that this aspect is a highly important one, and indeed paramount in many of the applications of the model petrol engine—which, I may add, never have been or will be neglected in *Petrol Engine Topics*—it is certainly by no means the only aspect worth while in model engineering. One might just as well ask why any elaboration or refinement, beyond that required for sheer utility, should be introduced into any kind of model engine. The answer is that the engine is something more than a means to an end, it is a worthy end in itself, and every item in its design or equipment adds to the pleasure of its construction, and the ultimate pride of achievement. For this reason, the development of the multi-cylinder engine is worthy of encouragement, so long as it does not become an obsession which eclipses or side-tracks the equally important considerations of efficiency and compactness, in which the simpler single-cylinder engine is at present supreme.

Objectors to the development of the " multi," however, are very definitely in the minority, and most of my readers have expressed a very emphatic desire for further information on this subject. The mere hint that I am working on the



The " Seal " 15-c.c. engine in course of construction. (Machining by R. C. Marshall)

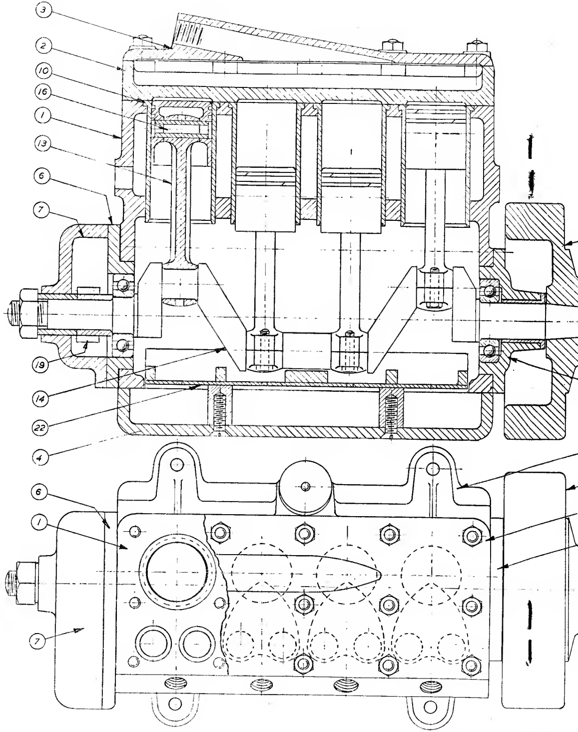
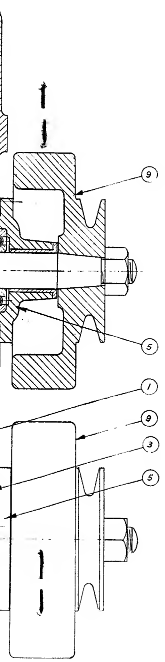
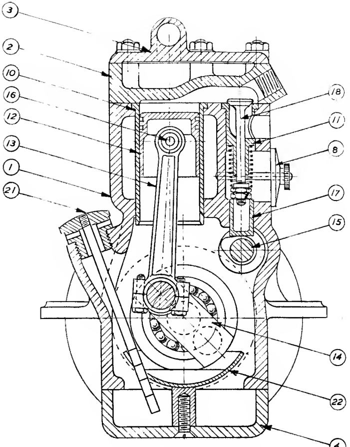
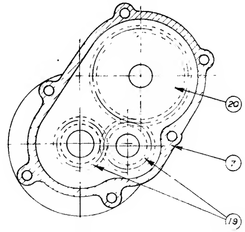


Fig. 1. *General arrangement of the "*

(1) Main cylinder and crankcase block ; (2) Cylinder-head ; (3) Cylinder jacket cover ; (4) Sump ; (5) Main bearing Housing ; (6) Timing-ge
(13) Connecting-rod ; (14) Crankshaft ; (15) Camshaft ; (16) Gudgeon-pin ; (17) Tappet guide ; (18) V







ARRANGEMENT OF TIMING GEARS

ngement of the "Seal" 15 c.c. engine

Housing ; (6) Timing-gear housing ; (7) Timing cover ; (8) Valve cover ; (9) Flywheel ; (10) Cylinder liner ; (11) Valve liner ; (12) Piston ;
Tappet guide ; (18) Valve ; (19) Timing pinions ; (20) Timing spur gear : (21) Breather ; (22) Oil trough.

development of a multi-cylinder engine myself has been sufficient to arouse a clamour for the drawings of the engine, and I find that readers are not content to wait for the indefinite time necessary for me to complete the development work on the design.

The engine in question, general arrangement drawings of which are shown on pages 198 and 199 is a "straight four," water-cooled, side-valve engine of 15 c.c., on which I have been working for quite a long time now, and a good deal of practical work has been put into construction and development, with the aid of several friends who are keenly interested in the project. It is my intention to produce designs for engines of both 15 c.c. and 30 c.c., and equipped with either side or overhead valves, but as the smaller size of engine is the more exacting, it has been selected as the one to be tackled first.

There have been quite a few delays and hold-ups in the progress of this work, but to reassure readers who may have any misgivings on this point, I would mention that these have been concerned with ways and means of production rather than design; questions of the availability of correct materials, machining methods, and delicate problems of patternmaking, of moulding, have caused quite a few headaches. These snags have gradually been ironed out, and I hope to be able to show readers alternative methods of construction to cope with such difficulties as they may encounter in these respects. As to the success of the engine, when built correctly to the design, I am in no doubt whatever, as sufficient experience has been obtained in experimental work to ensure that the engine will work according to plan.

The Object of the Design

Although, as already pointed out, one does not really need an excuse to build an interesting type of model engine, I may mention that the design has been produced for a definite purpose; but its application is by no means confined thereto. It has long been my intention to provide a really suitable power unit for model prototype boats, and in particular, those of the launch or cruiser type, which are deservedly popular in regatta events, such as nomination and steering competitions. Of the many boats of this type in existence, a very large proportion are now equipped with petrol engines; but while the latter may be quite satisfactory in performance and reliability, few of them are of a really appropritype, in respect of design and character, for marine installation.

How often does one find, after inspecting the exterior of a model boat on which every loving care has been bestowed to get all details correct and complete, and to preserve the true nautical "atmosphere," that all illusions are shattered on looking down the engine-room hatch! Without casting any aspersions on the usual commercial type of petrol engine, the sight of it in a ship's engine-room gives one quite a shock, and is often rendered worse when its shortcomings for the particular purpose are imperfectly remedied by the addition of a crudely-made cooling fan, or a tin water-jacket and a yard or two of rubber "plumbing."

This is not an exaggerated picture; I have seen it in many otherwise excellent model power-boats, both in regattas and exhibitions. It is an object lesson on where the utilitarian creed ("If it does the job, it's O.K.!") is liable to lead us eventually. I offer no criticism of those who, for want of a more appropriate power unit, have been compelled to use the only available means of motive power, but I do say that it is not good model engineering, and that there is a very strong case for the introduction of engines which are in harmony with their environment.

It may, perhaps, be objected that the design of the "Seal" engine illustrated here is more in keeping with automobile than marine practice. That is perfectly correct, and the reason is because the former lends itself more readily to simple and straightforward methods of construction; but it is also true to say that automobile engine design has been used as a basis for some of the most successful light marine engines, and in modern motor craft, conversions or adaptations of automobile engines are becoming increasingly popular. Even for models of the larger types of boats, such as tugs, coasters or even motor liners, the prototypes of which have much more specialised types of engines, the four-cylinder engine is by no means so blatantly discordant as a single, and moreover, fits in much better with the available space and shape of the engine-room. Should the occasion demand, there is no reason why two, or even more, engines of this type should not be installed.

Most of the multi-cylinder engines so far produced have been too large for installation in hulls of the size popular among model power-boat enthusiasts. Large boats are not only unwieldy and expensive to build, but an even more serious objection is the difficulty of transporting them. I know of one stout fellow who habitually carries around a 6-ft. boat, but he is by no means popular on crowded 'buses and trams with this strange cargo, and even on the railways, it has on more than one occasion been something of a "white elephant." The "Seal" engine is suitable for installation in a metre boat, without being either too heavy, or out of proportion in respect of bulk; and its power output is ample for the requirements of any craft of this size, other than those intended for racing on the circular course.

This, then, is the primary *raison d'etre* of the "Seal" engine, but it is also quite suitable for other purposes, such as installation in a scale model motor-car (other than a racer), a model locomotive, or even for stationary work such as driving a portable generating set.

Adaptability

It is quite in keeping with the spirit and tradition of model engineering that no two constructors require or prefer quite the same thing; individuality both in thought and effort is an essential factor in the make-up of the successful model engineer. In all my designs of engines produced in recent years, I have recognised this fact, and have allowed for the possible deviations which constructors may wish to make from the set design. Not only are several of the minor features of the design optional, but the arrange-

ment of the main components can also be modified as required. This ability to "ring the changes" has proved to be one of the most popular attractions in several engine designs, and is by no means lacking in the present example.

Thus the main casting can be turned either way round, so as to bring the valve gear on either the port or starboard side; this entails making provision for the attachment of the timing gear to either end of the engine, the castings for the timing case and bearing endplate being "handed" right or left as required. The water circulating system may be arranged so that the water enters or leaves the jacket at either end, this again calling for right- or left-handed castings for the cylinder head cover plate. These optional features may not be of very great importance when only one engine is to be installed, and no serious restrictions of space exist, or exact adherence to a set arrangement has to be complied with; but they are important when engines have to be used in pairs, to drive contra-rotating propellers.

The auxiliary engine fittings such as manifolds, ignition gear, carburettor, water and oil pumps, are not illustrated in Fig. 1, but it may be observed that these have been fully worked out, and give equal scope for versatility in detail or arrangement. A combined induction and exhaust manifold has been designed, and is shown in position in the photographs. The ignition distributor is fitted on the timing end of the engine, and may be driven directly off the end of the camshaft, as in the "1831" engine; but, for marine work, it is considered preferable to provide a vertical fitting, the shaft being geared to the camshaft, and extended downwards to drive a water circulating pump. Either gravity or forced lubrication is provided for, the former being quite reliable for normal work. A simple form of automatic carburettor, which will give a full range of speed control on the throttle lever only, has been designed for this engine, and although not specified in the standard design, the possibility of equipping the engine with magneto ignition has not been lost sight of, and will be dealt with in an appropriate manner.

It will be clear to most readers that the scheming out of a design to provide such complete equipment, and so many alternative features, has not been a five-minute job, but has taken up several months of spare-time work on the drawing board alone, in the course of which many major and minor parts of the design have been successively evolved and ruthlessly scrapped. An even greater task than that involved in the technical problems of design has been the solution of the machining problems, each one of which has been individually tackled, with due regard to the equipment which the average model engineer will have available to carry it out. The result, I dare venture to assert, is fairly satisfactory from most practical points of view, and although I cannot hope that the design will satisfy all my critics, I have little doubt of its general popularity.

A word of caution to those ambitious constructors who are itching to get going on an advanced design of engine: don't start building this engine until you have weighed up all the difficulties involved, and are quite confident of your ability to carry out all the work to the exacting degree of precision required. Theoretically, it is no more difficult to build a four-cylinder engine than a single of the same bore and stroke, the only difference being the *quantity* of work involved; but in practice, the success of a "multi" depends not only on the individual units, but also on their proper co-ordination. I do not underestimate either the ability or the perseverance of my readers, and I know from experience that even raw beginners are capable of overcoming the most formidable difficulties in construction, with totally inadequate equipment, at that; but it is sometimes difficult to get the beginner to realise just how big a job he is taking on. I have often been criticised for making things seem very difficult, but an ever-increasing number of readers are finding out that my policy of putting them on their guard about the difficulties and pitfalls ahead is better than pretending the latter do not exist. Quite a few people have thought that building small petrol engines was child's play—until they tried it! There are a few haphazard workers who have enjoyed beginner's luck, but most of us find that the best and most careful work we can do is not too good for this class of model construction. But as in other things in life, difficulties exist not to be dreaded, but to be overcome; and if there is any reader who is scared away from a job just because he is warned of its difficulty, all I can say is that he would never have made a really successful model engineer in any case.

(*To be continued*)

A Lathe Tailstock Tool Holder

(*Continued from page* 196)

moved around its axis so as to present the tool to the work at any convenient angle. One cutter will, of course, be set forward of the other and the shape of the cutters will be such as to give two diameters at the same time on the end of the stock. The cutters are fed up by the tailstock hand wheel. The stock is fed through as it is used by slacking the headstock mandrel chuck.

A cutting-off tool in the cross-slide will cut the job off when completed.

The hole in the back of the body A (screwed internally to take the screwed end of the taper on B) must be drilled first under the drilling machine, well under size below bottom thread diameter. Since no tap with such a diameter and a fine thread will be likely to be available, the thread must be screw-cut in the lathe. Bolt body A (by the tool-post slots already formed) to an angle-plate bolted to the lathe face-plate; centre to the drilled hole, turn out parallel to bottom, thread diameter and then screw-cut the thread to fit the plug B.

When setting up, the plug B should be driven very tight, by a hammer, into the tailstock barrel. It can be removed, as would a work centre, by rotation of the hand wheel.

Readers to Readers
Good Will Messages for 1947

HERE is a selection from the many messages of mutual goodwill between our readers sent in for our little New Year competition. As already reported, the poets are well represented and Mr. W. H. Bodfish, of Burnham, takes the lead with his verses, entitled "Carry On." He writes :—

Greetings for 1947 to Model Engineers
CARRY ON !

Yes, we've started one more year, carry on !
And the show will soon be here, carry on !
We've got lots of work to do,
With the chisel, saw, and glue,
And the lathe and grinder, too, so carry on !

When you give your thumb a whack, carry on !
And your loco. leaves the track, carry on !
You have cussed an awful lot,
And the boiler won't get hot,
But you must be on the spot, so carry on !

Never worry 'bout supplies, carry on !
It's your job to improvise, carry on !
"Old Curly's" gen is sound,
And if tubing can't be found,
Buy some sheet and bend it round, and carry on !

Though you've not yet won the cup, carry on !
Nothing's done by giving up, so carry on !
If your efforts won't come right,
Don't give in without a fight ;
Try again tomorrow night, and carry on !

Then we'll never hear it said (or in song)
British craftsmanship is dead (that's all wrong) ;
When we open our next show,
We shall prove to those who go,
It's far greater than we know, so carry on !

Honorable mention is accorded to the following rhymsters for their cheery contributions to THE MODEL ENGINEER collection of workshop verse : D. H. Facer, Matthew J. Morrison, A. G. Hicks, E. Sims and W. Tomsett.

"Live Steam" Good Will

The prize message in amusing vein comes from that well-known Yorkshire "live steamer," Mr. W. D. Hollings, of Bradford. His comprehensive greeting reads :—

"Hey ! All you wood and metal spoilers. Here's greetings. What good is it ? Why do you do it ? To all whose 'fingers are all thumbs.' To all who 'have not much oil in their cans, To all who have 'not got their chairs at home.' 'The cranks.' 'The back-room boys.' To all those who never do anything useful. To those who couldn't 'make a thing for toffee.' To all those who rouse and stink out the household and annoy the neighbours. I say good luck. We shall eventually outnumber the rest."

The Hon. Secretary of the West Riding Society of Live Steamers sends a special message of greeting to "all fellow club members, lone hands, and readers everywhere." He says :—

"At this time it is good to stop, think and take stock. Stop and look at the panorama of history—listen to the wise counsels of the ages."

New Year Designs

Mr. G. W. Lee, of Sidcup, presents what he calls "THE MODEL ENGINEER design for a Happy New Year." It runs :—

"A 'model' of cheerfulness 'constructed' with good humour, 'engineering' happiness. 'Chuck' in plenty of good fellowship, and 'machine' to 'widest tolerances.' 'Countershafts' of misfortune with a smiling 'faceplate,' and may you have a 'model' year."

The only artistic effort came from Mr. T. Griffiths, of Newport, Mon. He depicts an enthusiast working at his lathe with the spiral shaving from the cutting tool curling up into the message, "Happy New Year, Fellow Turners." An ingenious idea this, but not quite up to reproduction standard.

Good Wishes from Overseas

We quote one other message from Mr. Delvaux Nestor, of Antwerp. His English may be a little complicated, but the warmth of his goodwill is vividly apparent, and on behalf of the "great family" we thank him. He writes :—

"To the Great Family of Model Engineers,

"With the beginning of the New Year may I expressed the hope that in the future Model Engineers and enthousiasts all over the world will banish war and put instead, by possible disaccord, the tale of models. So we will never more see the destructions and murders of the last years, but we will come to a growing interest in the models of other people, wich in turn shall be a stipulation to do still better and will comme finally to the edification of a new world where Models and Model Engineers will take the first place. This are the whises of a Belgian reader who is proud of the "Model Engineer „ and already 20 years finds a father in its editor Mr. Percival Marshall."

Some New Year Resolutions

To round off this symposium here are a few New Year resolutions for general consideration and possible adoption :—

To finish off that model in time for the next MODEL ENGINEER Exhibition.

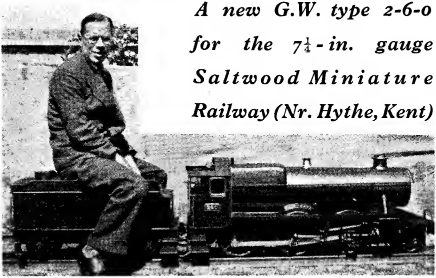
To join a local society and pull my weight in making it a success.

To keep my workshop tidy, and my tools in good condition.

To refuse to be beaten by a failure or a difficult job. Say "It can be done," not "I can't do it."

To be proud of being a model engineer, and to spread appreciation and understanding of the many virtues of the hobby.

To contribute photographs of your models, workshop hints, correspondence, and any other items to THE MODEL ENGINEER for the interest and benefit of your fellow-readers.



A new G.W. type 2-6-0 for the $7\frac{1}{4}$-in. gauge Saltwood Miniature Railway (Nr. Hythe, Kent)

"The Maid of Kent."

by A. C. Schwab

PUBLIC opening of the Saltwood Miniature Railway on two afternoons a week during August and part of September was first tried, very tentatively in 1935, at the suggestion of Lt.-Col. R. B. Tyrrell, whose acquaintance I had happened to make a short time previously.

This gentleman's $7\frac{1}{2}$-in. gauge line is well known to all travellers on the Romney, Hythe and Dymchurch Railway, situated as it is close to the Littlestone Station of that 15-in. gauge line.

Colonel Tyrrell's experience with public running led him strongly to recommend it for my Saltwood line, so a start was made, in a very modest way and with no publicity apart from a large placard on the gate (fortunately situated on a busy thoroughfare), but people very soon got to know about it, both in the immediate neighbourhood and farther afield.

Up to the end of public running in spring, 1940 (at the time of wholesale evacuation of the district), the whole traffic had been handled by the Atlantic named *Trojan*—a large-boilered job rather on the lines of the Reid N.B.R. Atlantics.

For some time, however, it had been apparent that a second engine would be an enormous boon, if only to save the nerve-strain engendered by maintaining a regular public service with only one engine.

To her credit, it should be stated that *Trojan* never once failed; but she was beginning to "feel her age" after eighteen years of continuous service (during which time she must have run many hundreds of miles). So plans were made for a second engine, to be a joint product of Greenly Engineering Models Ltd., of Heston, Hounslow, and ourselves (i.e. my father and myself).

Roughly, Greenly undertook the construction of the "chassis," the boiler shell (minus any fittings) was by Goodhand, of Gillingham, Kent, and we were responsible for everything else, i.e., boiler mountings, cleading, smokebox, chimney, cab, splashers and superstructures generally; also, the tender and all finishing, such as painting, etc., and a mass of intricate detail work, such as little syphon lubricators, etc., and many other very finicking and time-consuming jobs. The total man-hours were thus shared between Greenly and ourselves roughly 50 : 50, I should say.

The blueprints for the chassis were "hammered out" (as the Press is so fond of saying of political blueprints) at several long conferences at Greenly's office, and after five seasons' public running I had, of course, acquired a fund of knowledge and very definite ideas as to where *Trojan* "fell down" (chiefly due to lack of adhesion).

As is inevitable with a 4-coupled engine of relatively light weight and high tractive effort, *Trojan* suffered badly from slipping, and this was, of course, accentuated by the greasiness of the rails, due to continuous running round and round a short track (1 lap = 200 yards, approximately).

Consequently I wanted, first and foremost, a six-coupled engine and definitely a mixed traffic

type with wheels of moderate size because of the constant speed restrictions due to sharp curves.

Some account of the layout of the S.M.R. was given in an article which appeared as a three-part serial in THE MODEL ENGINEER a good number of years ago; but, for the benefit of those readers who may not be acquainted with it, a brief recapitulation may not be out of place.

The length of the line is 610 ft. and, apart from a 130-ft. stretch of straight (known as "the long straight"), on which the station is situated, and one or two other very short lengths of straight, it is all on curves of either 50 or 60 ft. radius (even sharper at one or two spots).

A Different Story

Apart from a brief rise of 1-in-100 immediately after leaving the station, the gradients are relatively easy (not more than 1-in-330 up in normal direction of running, though there is a short fall at 1-in-200 through the tunnel). But when one "compensates" for curvature (a common practice on railways in the colonies and elsewhere) it is a very different story; for instance, immediately at the top of the above-mentioned short stretch of 1-in-100 up one strikes a 45/50 ft. radius curve which, although *dead-level*, causes greater resistance (with a fully-loaded train some 50 ft. long) due to flange friction *alone* than this 1-in-100 up-grade; actually, I estimate it at equivalent to 1 in 75 or 80 up at least, and this continues most of the way up to the summit.

Consequently, it will be seen at once that powerful engines are needed to haul 15-to-20-passenger loads, equivalent to 450- to 550-tons train-loads to scale.

ance (a great improvement on the "Halls" with their shorter chimneys and generally more squat appearance) and their obvious efficiency on all classes of traffic from slow freight to the "Cornish Riviera" express between Plymouth and Penzance.

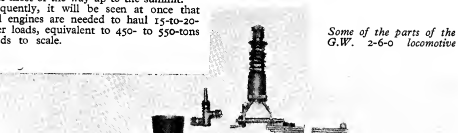
It was soon found, however, on examining diagrams of wheelbase against curvature that this 4-6-0 wheelbase was impracticable and would cause excessive overhang and grinding on the curves, etc., not to mention clearances of bogie wheels and cylinders, etc.; in fact, it was quite obvious that the only practical six-coupled type was a 2-6-0, and even this would be satisfactory only with the aid of the Krauss-Helmholtz articulated pony-truck.

Briefly, the design data were:—

(1) Six-coupled wheels (5 ft. 8 in. to scale) × Krauss pony-truck.

(2) A 2-6-0 with narrow firebox and short boiler barrel in preference to a 2-6-2 with wide firebox and long barrel, because of the fuel used, anthracite, which gives practically all its heat by direct radiation from the fire-bed and very little by convection from hot gases and flames, hence requiring maximum fire-box volume and heating surface and only small tube-heating surface.

A smaller boiler in every respect than *Trojan's*



Some of the parts of the G.W. 2-6-0 locomotive

The nominal T.E. of *Trojan* is 80 lb., and this was none too much; so that it was decided to work for a 100-lb. T.E. on the new engine. It was found that this could be obtained with the same boiler pressure as *Trojan* (85 lb.) if the cylinders were a shade larger, 2 in. × 3 in. as against $1\frac{15}{16}$ in. × $2\frac{7}{8}$ in., and the driving-wheels reduced from $9\frac{3}{4}$ in. to $8\frac{1}{2}$ in. diameter.

About this time (1938), the "Grange" class 5-ft. 8-in. 4-6-0s had appeared on the G.W.R. and greatly took my fancy, both for their appear-

was considered an advantage if only to secure a higher smokebox temperature and hence drier steam with the simple coil-type steam drier which is all the superheater provided.

With *Trojan* is was almost impossible to prevent continuous blowing off at the safety-valves, even with a relatively "black" fire; consequently, the steam tended to be wet, not that this mattered much, as she had plenty of *power*, but I was continually getting my spectacles obscured by a "spume" of grease and moisture

from the exhaust, and this was particularly objectionable in damp and showery weather.

(3) 100 lb. tractive effort for easier starting.

(4) Walschaerts gear *outside*, in spite of not being current G.W. practice.

(5) Slide valves on top of the cylinders, (*Trojan's* are between the cylinders, inside the frames.)

(6) The most massive bearings, particularly for side rods, bushes, big and little ends, etc., consistent with good appearance.

Apart from my stipulation of Walschaerts gear and my request for massive bearings, I left the design of the chassis to Greenly, although certain features, notably the cross-head and slide bars, raised points of discussion. I was rather in favour of the single bar slide, with a second bar superposed above, as on certain of the Maunsell Moguls on the S.R. for example.

against the outer rail instead of sliding sideways as it was supposed to do, the strong spring simply acting as a fulcrum and not compressing at all, thus causing a "crab-wise" effect on curves.

However, the weaker side-control springs got over this difficulty entirely and the Krauss now functions perfectly, incidentally giving riding at speed fully equal to an engine with a leading 4-wheeled bogie and complete freedom from "nosing."

Coil spring are fitted throughout engine and tender, though the tender has, of course, the usual dummy leaf springs, the coil spring being concealed behind the buckle in the usual way.

As *Trojan* is definitely too lightly sprung, it was decided to increase the strength by 50 per cent. on the new engine and this proved just right, as the riding is perfectly steady without being "hard."

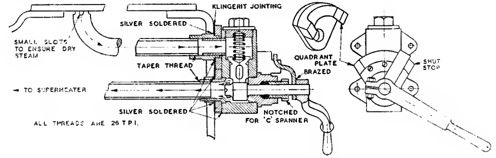


Fig. 1. *Cam-operated poppet-valve regulator*

Trojan, as originally built, had only single slide bars of somewhat inadequate section and, as a good deal of play soon developed, I fitted a good-sized bar above the slipper to share the up-thrust when running forward. This proved very successful and also has the great advantage of keeping the wearing surfaces well protected from grit.

However, on going into details, Greenly found that he could not get sufficient clearance at the back owing to the large amount of side-play provided to the leading coupled wheels as part of the Krauss scheme, $\frac{1}{8}$ in. each side. Consequently, it was decided to follow normal G.W. practice and fit a 2-bar crosshead with the bars spaced well apart.

The crossheads are built-up with separate gunmetal slippers and secured to the $\frac{1}{2}$-in. diameter piston-rods by a couple of cotters each.

The Chassis

The chassis generally follows conventional lines, apart from the horns of the coupled axle-boxes, which are made from 1-in. × 1-in. × $\frac{1}{8}$-in. angle-iron instead of castings.

The only slight modification to the chassis (which was completed by Greenly just after the outbreak of war in 1939)—made after trying it out on the curves—was the fitting of much weaker side-control springs to the side control "plungers" of the Krauss pony, as it was found that the strong springs originally provided caused the leading coupled axle to be pushed hard over

On account of its far greater accessibility for oiling and repairs, outside Walschaerts gear was preferred to the normal G.W. Stephenson's gear as fitted to the Moguls, etc.

Apart from the "overhung" trunnion bearing of the link and the method of driving the valve-spindle *via* a rocking-arm and toggle-links in place of the more normal crosshead and slides, the gear follows conventional lines.

Regarding the above-mentioned drive for the valve-spindle, it is not, I think, at all common in this country (though I have seen at least one Maunsell Mogul with this arrangement), but was apparently very popular in German-built engines at one time, if an old "Borsig" catalogue I have seen is any guide.

The boiler shell, completely devoid of all fittings, was made by Goodhand, of Gillingham, and is of copper throughout. It is riveted and caulked, as in full-size practice, tested hydraulically to 200 lb./sq. in. and under steam to 100 lb., working pressure 85 lb./sq. in.

Fittings

Several of the fittings are of unconventional design, foremost of these being the regulator, which is an external fitting fastened to the back-head The handle is in the conventional position in the cab; but, owing to the size of the body of the fitting (made from a chunk of 1-in. × 1-in. square bronze bar with gunmetal flanges silver-soldered on), it projects back into the cab to a

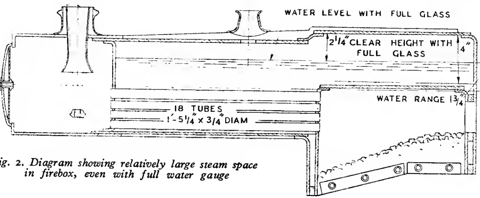


Fig. 2. Diagram showing relatively large steam space in firebox, even with full water gauge

greater extent than normal. This is, however, a distinct advantage in $7\frac{1}{4}$-in. gauge, as the driver need not reach forward so far, thus saving a lot of "backache" on busy days.

The idea of this external regulator was taken from the Surrey Border & Camberley Railway engines, but in place of a slide-valve worked by a "pull-out" type handle the scheme previously used with great success on *Trojan* of a poppet-valve lifted off its seat by a rotating cam was adopted. In the case of *Trojan*, however, the regulator-box is fitted on to the side of the smoke-box and the valve is operated *via* a long rod which also acts as the handrail on that side of the boiler. This tended to "whip" but, with the new engine the handle is attached direct to the spindle of the cam and there is no possibility of whip.

Allowance was made on the original regulator (for *Trojan*) for a lift of $\frac{1}{8}$ in. when full open, but it was found in practice that about half this amount sufficed to pass the steam "full-bore," and further opening of the regulator made no difference. Consequently, the maximum lift on the new regulator was reduced to about $\frac{1}{16}$ in., thus giving much more sensitive operation, and also avoiding the annoying tendency (with *Trojan's* regulator) of the valve to shut itself at small regulator openings due to the rush of steam and the cam being "reversible" in this position. With the "Maid" the regulator will "stay put" in *any* position and yet gives finger-light manipulation.

Steam is collected from the front top corner of the firebox (see diagram, Fig. 1) in the usual way (with domeless boilers), the mouth of the $\frac{1}{2}$-in. diameter copper pipe pressing up against the roof sheet and being provided with four small slots to admit the steam but keep out excess water.

A Surprise

One of the things that surprised me when I first drove the new engine was the dryness of the steam, but, of course, with a G.W. type boiler, and particularly one with a good big "step-up" from the top of the barrel to the roof of the Belpaire fire-box, one gets a larger steam-space, in spite of having no dome, than one would with a large-diameter high-pitched boiler *with* a dome—in effect, the fire-box steam-space acts as a big dome. The diagram, Fig. 2, makes this clear. Notice the large amount of steam-space in the firebox when the water is right up in the top nut of the water-gauge.

Even though the barrel is practically full (vigorous lifting of water at the safety-valve if she blows off hard reminds you forcibly of this!) there is still "bags of space" in the fire-box, and hence dry steam collected for the cylinders.

The only defect that has shown itself in service is a certain lack of water-capacity—the new boiler holds only about $2\frac{1}{4}$ gallons of water compared with about three with the Atlantic, and as she is a very quick steamer, the water level needs very careful watching. For this reason, it definitely pays to keep the water level high at all times, say, between $\frac{3}{4}$-glass and a "full pot," and on no account let the level drop below $\frac{1}{2}$-glass. With the dry steaming with high water-level referred to above, there is, of course, no objection to this; but there is no doubt that a larger capacity, and also more thermal storage effect thereby, would make driving a lot easier.

Easy to Examine

The great advantage of the outside location of the regulator valve is, of course, its extreme accessibility for examination, grinding, etc., as compared with either the dome or smokebox locations; all that is required is the unscrewing of the cap nut, when the valve is immediately exposed to view.

The safety-valve is a single direct-loaded valve (with only a very slight pop action) $\frac{9}{16}$ in. diameter, and advantage was taken of the large amount of head-room provided by the G.W. location on the barrel to provide a good hefty fitting with a generous length of spring—such a boon after the restricted height of *Trojan's* high-pitched "Royal Scot" type boiler. Another advantage of the G.W. position is that the steam does not blow directly in the driver's face as it does with pop-valves on the fire-box, and this is a big advantage for a driver who has to wear glasses.

The casing was made to an official G.W. diagram and was beaten up out of thick-wall copper tube.

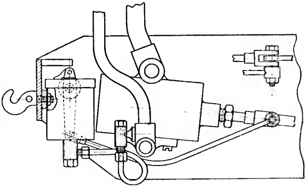
(To be continued)

"L.B.S.C." on Suggested Variations for "JULIET"

JUDGING from correspondence, and the amount of castings and material sold by various advertisers, this little simple locomotive would appear to be a winner, and a large number of them will eventually take the road; but some of the before-mentioned correspondence has caused your humble servant to chuckle a little! Before starting on the "serial," I received many requests to describe a $3\frac{1}{2}$-in. gauge locomotive of the absolutely simplest form of construction, combined with efficiency, to haul living loads on a small continuous line which could be accommodated in the average suburban garden. Also, to try and work it in between the instructions for building the "Lassie," so that any intending builders could get busy right away. Well, I did all that, as you know; but, bless your hearts and souls, no sooner do some of the very folk who asked for the simplest and quickest job, get their frames erected and the wheels on, than they immediately proceed to ask for elaborations—I guess I've made the job *too* easy! It was mentioned early in the description, that a link-motion could be fitted, by adding a few extra parts, and I said this variation would be described if required. Any amount of letters asking for the link-motion, have come to hand; and all being well, and no objections raised by our worthy friend of the blue pencil, this will appear in the next instalment of "Juliet." I had intended to hold it over until the completion of the engine as originally designed; but builders who want to fit link-motion, say they might as well do it before putting the boiler on the chassis, and I'm here to try and please all that I can, so it's your call.

Walschaerts or Baker Gear?

However, some builders have asked for details of a complete Walschaerts gear, preferring outside motion to one between the frames; and others who are rather tickled or intrigued by the simplicity and ease of construction of the little nest of rods and links, designed by the Baker who didn't know what a BU was (lucky fellow!) want to know if they can Bakerise "Juliet." It *could* be done, but I don't recommend it. For the start, both Walschaerts and Baker gears are primarily intended for cylinders with valves on top, whilst "Juliet's" are between the frames. That means having fresh cylinders altogether, necessitating a new design of cylinder, and completely altering the steam and exhaust pipe arrangements. True, the big 4-6-2 "Bessborough" of the old Brighton line, and the Baltic tanks, had outside Walschaerts gear with cylinders having steam chests inside the frame; but this involved a rocking shaft and pendulum levers for each cylinder, and if applied to "Juliet" would not only cause needless complication, but introduce more joints, and sources of lost motion, due either to wear, bad fitting, or both. If a beginner makes a poor job of the solitary pin joint in the loose eccentric gear, it isn't going to make any appreciable difference to the running of the engine; but if he "fits" all the joints of a Walschaerts or Baker gear, plus the rocking shaft and its connections, in a similar manner, the locomotive would cut a pretty fine caper when called upon to do a spot of real work. My honest advice to all who wish to reverse the engine with a lever, and notch up when running, is to fit the simple link-motion which I shall describe.



How to erect lubricator

Increasing Dimensions

Another batch of builders say the engine looks too tiny for $3\frac{1}{2}$-in. gauge, and suggests a bigger boiler and cylinders. This is entirely a matter for personal choice; and those who prefer, can convert her to narrow-gauge, making her the equivalent of a 3 ft. 6-in. gauge engine instead of 4 ft. $8\frac{1}{2}$ in. The cylinder bore could be enlarged as big as the castings would allow—say, to $1\frac{1}{8}$ in.—and instead of the small "standard gauge" boiler shown on the general arrangement drawing, a larger one, with a barrel $4\frac{1}{4}$ in. or $4\frac{3}{8}$ in. could be used. I believe some of our advertisers still have in stock, tubes of this diameter, as specified for "Bantam Cock" and "Maisie." This diameter of boiler would need a wide firebox, with a foundation ring either sitting on top of the frames, or let into a recess in them, something after the style of the ten-coupled edition of "Ada." Another suggestion was, in addition to the above, lengthening the frames and fitting another pair of wheels, making her an 0-6-0. I don't

quite see the idea of this at all, because I recently offered an engine of this type in these notes, to wit, "P. V. Baker," and anybody needing a six-coupled engine, had better tackle that one and be done with it; they would have no alterations to worry about, as the 0-6-0 already has cylinders with valves on top, Baker gear and a bigger boiler. Then probably they would be writing to me and asking how to fit "Juliet" cylinders to it—such is the perversity of human nature! I also don't see the slightest need of making "Juliet" into a tender engine, because she carries plenty of water in the side tanks, and it is easy enough to carry a little coal in a box on the front of the passenger car. The engine, as she is being described, is ideal for a kiddy who is learning how to handle a small steam locomotive; for the open-backed cab, and the absence of a tender, bring the handles within easy reach of short arms, and a youngster is not so likely to overbalance, or tip up the car.

A few readers want to know if an oil-fired water-tube boiler would steam sufficiently well to haul passengers. Yes, it would, with my recommended valve setting, and I'll give an outline of such a boiler if required; but the whole engine would get so confoundedly hot that she would probably be very uncomfortable to drive. The only saving grace would be that the feed water would automatically become very hot by absorbing some of the heat otherwise wasted through the boiler casing. A number of other variations were suggested, but as the old saw puts it, "Sufficient for the day is the evil thereof," and so let's get on with a few hints about mechanical lubrication, for those who desire to fit same.

Mechanical Lubricator

Although the displacement lubricator with regulating valve, previously described, would always ensure that the cylinders and valves got plenty of oil, the feed is not always regular, for reasons I have already explained; so here are the necessary details of a mechanical lubricator for those who like to take the trouble to make and fit it. Incidentally, my little Brighton engine "Grosvenor," will have one of exactly the same pattern, which is going one better than her big sister. As I explained very fully, for beginners' especial benefit, how to make all the components in the notes on "Petrolea," and again expounded fairly explicitly in dealing with the "Lassie's" twin-pump gadget, there is hardly any need to set down the complete ritual again; so I propose just to run through the job briefly. The illustrations are practically self-explanatory, and the veriest Billy Muggins should have no difficulty in making up and fitting the lubricator, which is as simple as the toy oscillating-cylinder steam engines with which our late enemy Jeremiah "invaded" the country before having a shot at doing the job in person. If Jerry's love for kiddies had been as great as his skill in making toys for them, the world would have been saved a great deal of misery.

Oil Container

The tank can be made from 18-gauge brass or copper; cut a piece $1\frac{3}{16}$ in. wide and 5 in. long, bend it into a rectangle $1\frac{1}{2}$ in. by 1 in., stand it on another bit (16-gauge if you like, to make a stronger bottom) a shade larger, silver-solder all round the joint and up the corner, and file the bottom flush with the sides. Drill a $\frac{3}{16}$-in. hole in the middle of the bottom, and another one $\frac{3}{16}$-in. from the top, on the centre-line of one of the shorter sides. A lid can be made by flanging a piece of sheet brass or copper over an iron former, measuring 1 in. by $1\frac{1}{2}$ in., same as you would flange a boiler plate; or alternatively, by cutting out a piece of sheet-metal $1\frac{7}{8}$ in. by $1\frac{3}{8}$ in., taking a $\frac{3}{16}$-in. square piece out of each corner, and bending $\frac{3}{16}$ in. of the edges to a right-angle, forming a sort of shallow tray. The corners may be silver-soldered, or left just as they are.

Oil Pump

The stand for the pump is made from a piece of $\frac{5}{16}$-in. square brass rod, squared off in the four-jaw to a dead length of $1\frac{3}{16}$ in. Centre one end, and drill and tap the hole for the stem of the delivery check valve. The stand can then be milled, or sawn and filed, as shown in the illustration, which gives all the particulars, also drilled for trunnion-pin, bearing, and ports. Beginners should note that these holes *must* go through square with the working face; so if you haven't a drilling machine, use the lathe, with the drill in three-jaw, and the stand held against a drilling pad in the tailstock barrel. Marking-out tips: scribe a line down the middle of the stand, and set out the location of the trunnion hole, $\frac{3}{8}$ in. from bottom. Set your divider points $\frac{1}{4}$ in. apart; and from the trunnion hole, strike an arc across the lower rubbing face. Set out the ports on the arc, $\frac{1}{16}$ in. either side of the centre-line. Don't alter the dividers, but when marking out your pump cylinder, scribe a centre-line as before, dot off the location of trunnion pin 21/64 in. from bottom, then with one point of the dividers in the centre-pop, strike a little arc cutting the centre-line. Dot the intersection, and that is where the port is drilled. The ports should then line up perfectly; and don't forget that the right-hand one is drilled right through into the hole in the bottom of the stand, whilst the left-hand one has a little groove cut from it, across the rubbing face, to the bottom, to allow oil to get into the pump cylinder.

After squaring off the ends of the pump cylinder in the four-jaw, set out on one end, the location of the bore, and make a centre-pop. Rechuck with this running truly; then drill No. 33, open out and tap for the gland, finally running a $\frac{1}{8}$-in. reamer through the remains of the No. 33 hole. A piece of $\frac{1}{8}$-in. ground rustless steel, or bronze rod, should fit exactly in the reamed hole; the slide-rule merchants will say "'as 'ow it shouldn't," but the fact remains that both my $\frac{1}{8}$-in. reamers mike up correctly to 0.125 in., and a bit of rod miking up to the same measurement is a lovely fit in a hole reamed by either of them, so that's that! The length of the ram is $\frac{7}{8}$ in.; the cross-hole for the crankpin should be drilled No. 48, and $\frac{3}{4}$ in. from the bottom. The gland is turned from $\frac{1}{4}$-in. hexagon brass rod, and screwed 7/32 in. by 40; the trunnion pin is a $\frac{7}{8}$-in. length of 3/32-in. silver-steel, screwed both ends, as shown. It must be

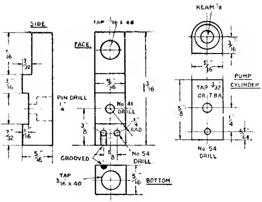
exactly at right-angles to the cylinder rubbing face. The spring is wound up from 24-gauge tinned steel wire, and secured by an ordinary commercial nut.

Operating Gear

The bearing for the crank spindle is a kiddy's practice job, being merely a piece of $\frac{5}{16}$-in. hexagon brass rod held in chuck and faced, centred, and drilled down about 1 in. with No. 41 drill. Turn the outside for 27/32 in. length to $\frac{3}{16}$ in. diameter, screw $\frac{3}{16}$ in. by 40, and part off to leave a 3/32-in. head. Make a nut to suit. The crank spindle is a $1\frac{3}{8}$-in. length of 3/32-in. silver-steel, screwed both ends, and furnished with a little crank made from a $\frac{1}{8}$-in. slice of $\frac{3}{8}$-in. round brass rod. The crankpin is a bit of 15-gauge spoke-wire, screwed into a tapped hole in the crank as shown, using 9-B.A. tap and die. The ratchet wheel is $\frac{7}{16}$ in. diameter, 3/32 in. wide, with 35 teeth; as Tom Glazebrook has now no time to make these, Dick Simmonds will supply. The wheel is drilled No. 43, and pressed on to the spindle, so that when poked through the bearing, and the crank screwed on, there is about 1/64 in. end-play.

Pawls

The ratchet lever is filed up from 3/32-in. by $\frac{1}{4}$-in. strip steel, or a bit of 3/32-in. bright sheet. As there is enough headroom for the moving pawl to be placed above the ratchet wheel, I have specified that position, as it gives more room for the stationary pawl on the side of the narrow oil tank. Both pawls are filed up from 3/32-in. steel, and case-hardened. The moving pawl works on a screw with a full 3/32 in. of plain part under the head, and slightly riveted over where it projects through the lever. A $\frac{1}{16}$-in. screw is tapped into the end of the pawl, and connected by a spring to the lever as shown, the bottom end either being fixed by another screw, or hooked into a $\frac{1}{16}$-in. hole in the lever. The stationary pawl is mounted on a little stud

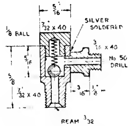


Pump stand and cylinder

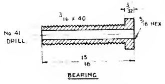
turned from $\frac{3}{16}$-in. steel rod; the end carrying the pawl is turned down to 3/32 in., put through a No. 41 hole in the pawl, and lightly riveted over. The other end is screwed 8-B.A., and goes through a No. 43 hole in the tank, with a nut on the inside. Both pawls must be perfectly free on their pivots, and the ratchet-lever should also be free on the spindle, without side play, when the nut is tight home.

Clacks

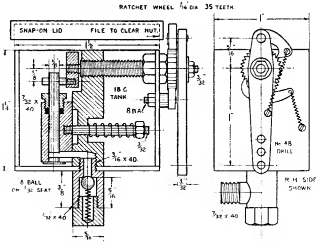
Two clacks, or check valves, are needed, made from $\frac{5}{16}$-in. brass rod. Both the insides are alike. Chuck the rod in three-jaw, face, centre, drill down about $\frac{3}{4}$ in. depth with No. 43 drill, open out to about $\frac{1}{4}$ in. with $\frac{3}{16}$-in. drill, and bottom the hole to $\frac{5}{16}$ in. depth with a D-bit. Tap 7/32 in. by 40, and don't let the tap scrape the seating; countersink slightly, part one off $\frac{5}{8}$ in. from the end, and the other $\frac{1}{2}$ in. Reverse the $\frac{5}{8}$-in. one in chuck, turn down $\frac{1}{4}$ in. of the end,



Delivery check valve



Spindle bearing



Mechanical lubricator for "Juliet"

to 7/32 in. diameter, and screw 7/32 in. by 40. Countersink the end, and poke a 3/32-in. reamer through the hole. The other end of the $\frac{1}{2}$-in. one is turned down for $\frac{1}{8}$ in. length to $\frac{3}{16}$ in. diameter, screwed $\frac{3}{16}$ in. by 40, and reamed as above. A 5/32-in. hole is drilled in the side of each. A 7/32-in. by 40 countersunk union nipple is silver-soldered into the hole in the $\frac{1}{2}$-in. one, and a $\frac{3}{16}$-in. by 40 screwed flange fitting, as shown in the section, fitted to the $\frac{5}{8}$-in. one. Both caps are turned from $\frac{5}{16}$-in. hexagon brass rod, and drilled No. 30; the springs are wound up around a bit of 3/32-in. rod, from steel wire of about 30 gauge. They don't need to be excessively strong; merely enough to retain the balls on the seatings at all times, as they tend to "float" in the heavy cylinder oil, and would not seat quickly enough to prevent back flow of the oil, if left without assistance.

Assembly and Erection

Beginners note—to assemble the pump, true up stand and cylinder rubbing faces as described for slide valves etc., and pack the little gland with a strand of graphited yarn. Screw in the trunnion, put it through stand, and put on spring and nut. Stand the whole doings in the tank, and screw the short clack into the stand through the hole in bottom of tank. Poke the bearing through hole in side of tank, put lock-nut on loosely, then screw bearing into stand until the head touches side of tank; then run lock-nut back against tank side, and tighten up. Put the crankpin through hole in ram, hold crank opposite bearing, push spindle through same, and screw into crank. Put on the ratchet lever, tighten up the delivery check-valve under tank, and Bob's your uncle. If some heavy oil is put in the tank (I use "Vacuum 600 W," or "Cyltal 81," but any good cylinder oil for superheated steam will do) and the ratchet wheel turned by hand, it should be quite impossible to prevent oil coming out of the union nipple by pressing your thumb on it, as these lubricators will pump to over 400 lb. pressure.

Erection is easy. Drill and tap the steam tee $\frac{3}{16}$ in. by 40—take the whole bag of tricks off to do this, and be sure to blow all the chippings out—and screw in the longer clack. Cut a segment $1\frac{5}{8}$ in. long, out of the top of the buffer beam, so that you can get at the lubricator for filling purposes. To hold the lubricator in the position shown in the illustration. If you haven't already made the draw-hook, drill a No. 41 hole at $\frac{1}{2}$ in. each side of the draw-bar hole, and on a level with it; countersink them. Solder a piece of brass rod $1\frac{1}{2}$ in. long, $\frac{1}{8}$ in. by $\frac{3}{8}$ in. section, to the front of the lubricator tank, just a weeny bit below the lid, as shown; then hold the lubricator in position, run the 41 drill in the holes in beam, making countersinks on the brass rod. Remove, drill the countersinks No. 48, tap 3/32 in. or 7 B.A., be careful to clear any chips out of the tank, replace, and secure by countersunk brass screws. When you have made the draw-hook, the stem of this can pass right into the tank through a No. 30 hole, and the nut put on inside the tank, thus killing two birds with one shot, by fixing the hook and providing extra support for the lubricator. The unions on the two clacks are then connected by a short piece of 3/32-in. pipe, having a union cone and nut on each end; the pipe should have a curl in it as shown, both for ease of fitting, and keeping the pipe as cool as possible.

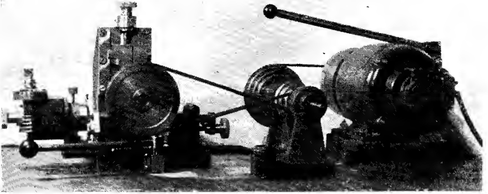
A drive for the lubricator is easily arranged by connecting the ratchet lever to the nearest valve-spindle by a piece of 13-gauge spoke wire, or silver-steel. A bush or bearing is made by chucking a piece of $\frac{5}{16}$-in. bronze rod, centring and drilling No. 30, and parting off a slice about $\frac{3}{16}$ in. in thickness. Drill and tap a hole in the side, 3/32 in. or 7 B.A., screw one end of the rod to suit, and attach bush as shown. The bush may be silver-soldered to the rod, instead of screwed, if you so desire. The other end of the rod carries a little fork or clevis, made same as the forks on the valve-spindles, but from $\frac{1}{4}$-in. square rod. This is screwed to the end of the spoke-wire connection, and attached to the ratchet lever by a 9-B.A. screw with $\frac{3}{16}$ in. of plain part under the head. The outer side of the fork is drilled No. 48, and the inner side tapped 9 B.A.; or you can drill both sides No. 48 and use a bolt, with nut on the inside, just as you prefer. The rod connecting the lever to the valve-spindle must be bent as shown, to clear the "obstructions on the line," and a $\frac{1}{8}$-in. bolt passes clean through valve fork, eccentric-rod, and bush, as shown in plan. This can be made from $\frac{1}{8}$-in. silver steel, shouldered down to 3/32 in. at each end, and furnished with commercial nuts.

The length of the rod, and its connection to the ratchet lever, is best obtained from the actual engine. With the loose eccentric gear, and a travel of $\frac{3}{8}$ in. on the valve-spindle, the fork may be connected to the bottom hole, and this should ratchet one tooth for every revolution of the driving wheels. With the link-motion, the valve travel will shorten as the engine is notched up, and the fork will have to be connected higher up the ratchet-lever; so put the reversing lever in next notch to middle, after the gear has been made and erected, and couple the fork to the hole that allows the lever to ratchet one tooth per revolution when the valve-gear is notched up to this running position. In full gear, it may ratchet two teeth per turn, but this will not matter, as the gear can be notched up almost as soon as the wheels begin to turn.

With a mechanical lubricator it is a simple job to provide a means of introducing what the enginemen call a "dope," that is, a small charge of oil in the cylinders to help starting from all cold. Drill a $\frac{1}{4}$-in. clearing hole through the side frame, opposite the lubricator spindle, to take an extension handle. This may be a piece of brass rod with a cross handle or wheel at one end, and the other either drilled and tapped to screw on the spindle outside the nut, or formed like a box spanner to go over the nut. For this, all you do is to drill a hole in the end of the rod, same size as the nut over corners; put a nut in, and hammer down on the flats, which will make the hole go hexagon-shaped. To use, simply insert the extension, connecting to spindle, and turn a few times. You will feel if the lubricator is pumping, as there will be distinct resistance when the oil forces its way past the spring-loaded ball valves in the clacks.

A GEAR-CUTTING MACHINE

By J. S. ELEY



General set-up, showing method of driving

IT was in January, 1941, that Mr. Westbury began his series of articles describing the construction of an I.C. engined locomotive. At that time, I had only been taking THE MODEL ENGINEER for two or three weeks, and was casting about for something to make as a "first attempt." The idea of this engine appealed, and the first week that the first constructional article appeared, a start was made. Although we started level, Mr. Westbury soon left me far behind, in fact, I have not yet finished the course, although the model is now well on the way to completion.

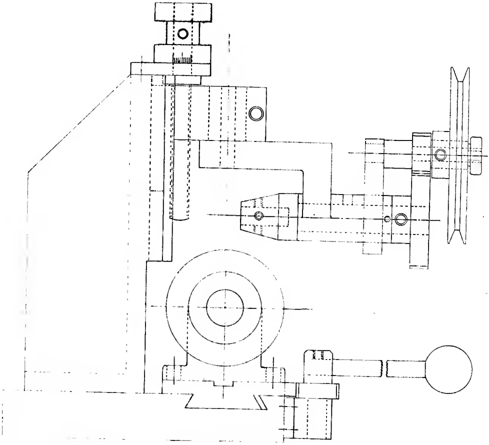
Workshop Equipment

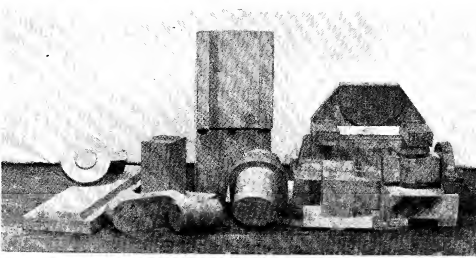
One reason for this is that at the time my workshop was still in the embryo stage, and lacked all those small special tools, lathe accessories, and gadgets, that the model engineer makes for himself as he goes along. Consequently numerous diversions were made to repair these deficiencies, and the result was that more time was spent in making workshop equipment than on "1831." Many of these jobs became very interesting, and were made more elaborate than originally intended —a temptation very easily fallen into. The making of models is, or should be, the chief aim of a model engineer, but it is very tempting to wander off and flirt with the design of tools and equipment. It needs a nice discrimination to steer a middle course, and avoid being known as a "collector of tools." The forming of the radius on the buffer heads was the first problem to be tackled, and a special topslide with a rotary movement was made. Next came a milling spindle driven by a flexible shaft. This was used later on as a grinding spindle to grind the engine crankshaft all over. Incidentally, I found this was the easiest way of forming the fillets at the web roots, the grinding wheel being suitably radiused. A filing rest and numerous small tools were also made, and then came the problem of producing the spiral gears for the transmission, and also the spur gears for timing. I had no means at all in my workshop of producing gears of any type, and at first proposed to make an attachment for the lathe to cut the spur gears, and follow Mr. Westbury's method of producing the spiral gears. Both methods were not without snags, however, and it was at this point that I interested Mr. George Fisher, of Leeds, in the problem of generating spiral gears. To cut a long story short, he got out a design for the machine which forms the subject of this article.

Although measuring only 12 in. × 8 in. × 12 in. high, it will produce spur, spiral, double helical, and bevel gears, up to a diameter of 4 in. The smallest gears so far cut are $\frac{3}{16}$ in. diameter. In general design the tool resembles a small milling machine, but with several notable differences. In the first place, no cross traverse is provided, as in the present case it is really unnecessary. Instead, collars of varying widths are used to centre the gear cutter on the centre line of the machine table. Secondly, the cutter spindle is carried in an arm which swings about the vertical centre line of the machine. This is for setting the cutter over to an angle corresponding with the spiral angle of the gear to be cut, and is contrary to usual practice, where the table itself is made to swing. The third unusual item is the dividing head. In addition to the worm-driven movement for dividing, the whole unit is made to revolve completely round on its own axis. The purpose of this feature will be dealt with later.

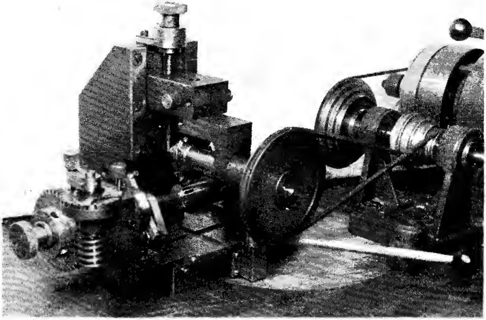
Construction

Extensive use was made of castings, as several parts have a large overhang, and maximum rigidity was thus obtained. The base is simply a flat piece of cast-iron dove-tailed to take the





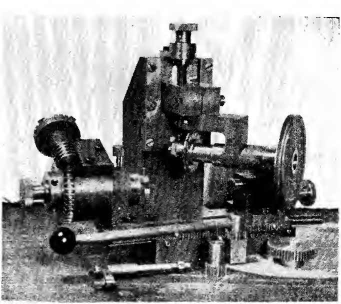
Patterns, including those for bevel gear attachment



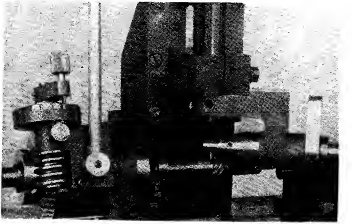
The machine cutting its own gears

table. The 60-deg. slides in both base and table were milled out with a fly-cutter consisting of a flat piece of high-speed steel brazed to a plain round shank and ground to 60 deg. At the time that this machine was made, I had access to a milling machine, and so advantage was taken of it. However, the machining is just within the capacity of my 5-in. lathe, and I have since done similar work on it. The table again is simply a flat piece with a shallow groove milled down the centre of the upper surface. This groove receives tongues on both dividing head and back centre, so keeping them in alignment. The side of the table carries a rack engaging with the pinion used for applying the feed. This pinion can be lifted out of its bearing and dropped into any other position of engagement with the rack that may be necessary. This method is more convenient than a screw, particularly when cutting spirals.

The dividing head is of most unusual construction. As can be seen, it is fixed permanently to one end of the table, and overhangs it to allow of complete rotation. The worm is carried in a bracket, which in turn is screwed to a cast-iron drum. This drum is free to revolve, thus allowing the whole assembly to rotate, but at the same time allowing the spindle to be indexed in the usual way. When generating spirals, the rotation of the



Showing two driving gears after cutting



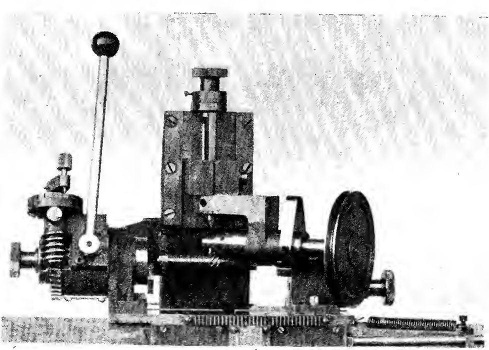
Showing fly cutter used for small spiral

dividing head, and thus of the gear blank, is controlled by a sheet-metal cam, the edge of which bears against a roller carried on a bracket attached to the main casting. This arrangement can be seen from the photographs. The drum to which this cam is attached by three screws is split and can be clamped up tight when cutting spur gears, as the rotating feature is not required when cutting straight teeth.

The dividing head centre is of the draw-in type, and is interchangeable with lathe collets. The division plates had necessarily to be on the small side, and so were simply notched with a slitting saw on the outer edge. They can thus be produced readily on a milling machine with a dividing head. I have plates with 21, 24, 26, and 27 notches, which with the 40-tooth worm wheel, give me all the divisions I am likely to require. The sector arms are a copy of the full-size type. Incidentally, the worm and wheel were the only parts procured ready-made. The back centre is of orthodox type, and calls for no special comment, except the small centre point, which allows gears of very small diameter to be cut.

The main casting is of box form. A plain channel-type slide is machined in the upper half, which with two keep plates holds the rising and falling member. These are for location only, as when cutting, a bolt passing through a vertical slot in the casting locks the assembly rigidly. Vertical adjustment is by a knurled knob and B.S.F. screw, a collar graduated in thousandths being provided for setting. A micrometer head can also be fixed in position for critical adjustment if necessary.

(To be continued)



Set-up for cutting small spiral gears (" 1831 "). Note feed applied to dividing head

Letters

How Basingstoke Does It

DEAR SIR,—Since my last letter our society has been extremely busy sorting itself out, and for that reason I have not given you any specific details.

I must say at once I have no literary talent and I am at a loss to condense a lot of information into a small space. Nevertheless, our " society " would like to be put on the map, so to speak; and to have a good mention in THE MODEL ENGINEER, we would indeed be very grateful.

The society is at the moment in the early stages of organisation. Starting from scratch as it were, we have to provide ourselves with a meeting room and a reasonably equipped workshop. Meetings are held on the first and third Mondays monthly, at 7.30 p.m., in the Potters Lane Assembly Rooms. A qualified speaker is invariably present to give a short homely talk on a subject of interest to our members, such as :— " Metal Hardening," " Gears and Gear Making," " Grinding," " The Petrol Engine," " The Diesel Engine," " The Lathe," and kindred subjects. This talk is quite informal and comfortable and usually lasts 15 to 20 minutes. Questions and discussion follow, but no question is considered too lowly, as we are so widely separated in our hobbies. There is also always someone present with a pet " model," a steam engine, a tractor, a scale model of a ship, 'plane or glider, or a component, who will show it around, and talk about it, its idiosyncrasies and difficulties, thereby gaining help and advice.

The membership consists of those who in ordinary occupation are joiners, carpenters, builders, turners, machinists, metal workers, general engineers, draughtsmen, a watchmaker, a doctor, a bank official, a schoolmaster and many others, including foremen in their respective trades. Never in the course of my experience have I seen a more comradely bunch of assorted individuals. Above all we are blessed with a spendid leader and chairman, Dr. G. Romanes.

For the practical side we have been fortunate in securing an old disused barn at a very low rental, but this requires a great amount of work to install benches, lighting, heating and general repairs. All this, of course, is under way. A " Director of Operations " is in charge, who doles out certain tasks to teams of workers. It is not everyone who can find time to put in at the workshop, but we are getting along very nicely. Certainly there have been difficulties, but we have overcome most of them, and, being a happy crowd, we enjoy every moment.

When the workshop is ready, we shall from time to time, as funds will permit, purchase equipment for the purpose of not only our own model-making, but to instruct the junior section (these being between fourteen and eighteen years of age). We are shortly starting a mutual aid plan of model making, that is, two or three members working on one model—one or more members not having had experience in that particular line.

There is so much to be done and so many possibilities open to an organisation such as ours that one cannot at once make clear our future intentions. Most of the business of the society is done by the committee, who meet at least monthly, but where necessary the actions of the committee are endorsed by the members.

The committee have expressed their indebtedness and thanks to Mr. W. H. Corthall, of Andover, for his efforts which resulted in the formation of the Basingstoke Society.

59, Oakley Lane, Yours faithfully,
Basingstoke. G. MABE, Hon. Secretary.

[The foregoing letter so well describes the development of a modest but enthusiastic society, that we give space to it in full, instead of condensing it to a restricted report, as is customary in our Club Columns. Other recently formed clubs may get some hints from Mr. Mabe's interesting story.—ED., " M.E."]

Worm Gear Principles and Notes

DEAR SIR,—I was pleased to see Mr. F. L. Berry, in his article, pp. 12-14 of the January 2nd issue, call attention to the fact that worm gearing plays an important part in modern power transmission in all fields and welcome his comments on the terminological inexactitude relating to worm-gear parts in general engineering.

I would suggest that the adoption of terms defined in BSS. 721/1937 for pitch, lead, lead angle, root diameter, etc., will facilitate concise and accurate description with minimum confusion.

A lead angle may be small, but not " flat," as any point on the pitch line of a worm is a point on a curve, and a gear having a small lead angle will not necessarily act as a brake. Having been intimately connected with gears, and particularly worm gears, for more than ten years, I can say that present methods of manufacture produce worms and wheels so accurately and of such a high degree of surface finish that gears are in operation having a ratio of 60 to 1, with a lead angle of 4 deg. 24 in., which cannot be relied upon to hold a suspended load stationary, the load driving the motor through the worm and wheel and producing acceleration from standstill. A brake must be used for safety.

Worm diameters are kept small, consistent with resistance to bending, to keep rubbing speed low, as a high rubbing speed reduces wear capacity. Pitch is selected to give adequate strength and ensure that the gears do not fail due to fatigue, whilst traction gears have heavier pitches than industrial gears of the same centre distance, due to the much higher specific loading.

The best material for worms is a casehardening steel, and worms of this material working with centrifugally-cast phosphor-bronze wheels, give wear and strength capacities generally similar to the heat radiating capacity of a fan-cooled gearcase.

The most economical ratios are from 5 to 60 to 1 in single reduction units, whilst 10,000 to 1 seems to be the practical limit in double reduction units. Equal ratio gears are quite practical in addition to increasing gears, some units in operation giving an increase from 1,440 to 20,900 r.p.m.

I trust the above comments will give some idea of the versatility of worm gears and extend the scope of Mr. Berry's article.

Yours faithfully,
Huddersfield. J. W. PEAKE,
A.M.I.Mech.E., A.M.I.A.E.